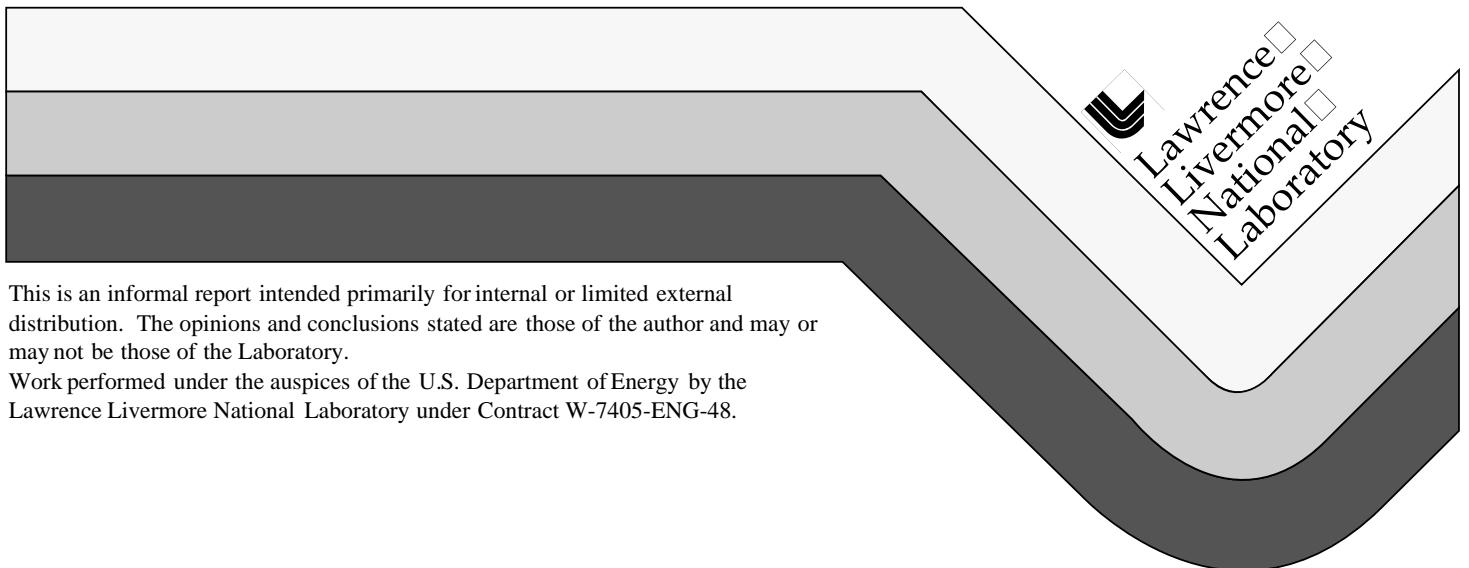


Measured Data Used in the Watusi Cross-Section Sets

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Measured Data Used in the Watusi Cross-Section Sets

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Introduction

In this document we list the experimental data that were used to make up the major cross-section sets that we use in the Watusi code to calculate the amount of detector activation in device tests. In order to use experimental data to make up a cross-section set, it is often necessary to extrapolate the cross sections down to either the threshold energy or to 0.01 keV, and to extrapolate up to 20 MeV. We then fit the data to a function so that we can get a smoothed set of interpolated values at up to 321 energy points. The combined data are then processed with the Hiroshima code into flux-weighted, group-averaged cross sections for use with the output from the different physics design codes. We typically use the standard 53 or 175 energy group structures.

In a recent companion memo¹ we described the make up of all of the cross-section sets in detail, giving references to both the experimental data and the theoretical calculations that were used. The following sections have the experimental data, in the form of energy-cross section pairs, for the titanium, chromium, bromine, krypton, yttrium, zirconium, iodine, europium, lutetium, and bismuth sets. The other cross-section sets are not directly based on enough experimental data to warrant their listing here.

Many of the reactions used in these sets are based on calculated cross sections. In making these calculations certain parameters are sometimes adjusted so that the calculated cross sections match experimental data. In some of these cases we have made a further normalization to give a closer agreement to selected experimental data, and such normalizations are noted in this document. In other cases no further normalization was made.

In Table 1 we summarize the reactions for which we present the experimental data given in Tables 2-46. In Figs. 1-35 we show plots of the experimental data together with the actual excitation functions used in the cross-section sets. Some reactions in the current sets are based on preliminary experimental data for which final results are now available. In those cases we show both the preliminary and the final data on the same plots. We expect to find only a few percent change in the calculated activation when we switch to the final experimental data.

Table 1. List of reactions. Tables 8-11 and 27 have new data that have not been used in the cross-section sets, and therefore are not shown as figures.

<u>Reaction</u> <u>Figure</u>	<u>Table</u>	<u>Figure</u>	<u>Reaction</u>	<u>Table</u>
48Ti(p,n)48V	2,5	1	89Y(p,n)89gZr	23 16
47Ti(d,n)48V	3,6	2	89Y(p,n)89mZr	23 17
48Ti(d,2n)48V	4,7	3	89Y(p,2n)88Zr	24 18
46Ti(t,n)48V	8		89Y(d,2n)89gZr	25 19
47Ti(t,2n)48V	8		89Y(d,2n)89mZr	25 20
48Ti(t,a)47Sc	9		89Y(d,3n)88Zr	26,2 8 21
47Ti(d,an)44gSc	10		89Y(d,2n)89Zr	27
47Ti(d,an)44mSc	10		89Y(n,2n)88Y	29 22
46Ti(d,a)44gSc	11		90Zr(n,2n)89gZr	30 23
46Ti(d,a)44mSc	11		90Zr(n,2n)89mZr	30 24
52Cr(p,n)52gMn	12	4	127I(p,n)127Xe	31 25
52Cr(d,2n)52gMn	13	5	127I(d,2n)127Xe	32 26
50Cr(d,a)48V	14	6	127I(n,g)128I	33,3 4 27
79Br(p,n)79Kr	15	7	151Eu(p,n)151Gd	35,3 9 28
79Br(d,2n)79Kr	16	8	151Eu(d,2n)151Gd	36,4 0 29
81Br(p,n)81Kr	17	9	153Eu(p,n)153Gd	37,4 1 30
81Br(d,2n)81Kr	18	10	153Eu(d,2n)153Gd	38,4 2 31
80Kr(n,g)81Kr	19	11	151Eu(n,g)152Eu	43 32

78Kr(n,2n)77Kr	20	12	153Eu(n,g)154Eu	44	33
80Kr(n,2n)79Kr	20	13	152Gd(n,g)153Gd	45	34
78Kr(n,g)79Kr	21	14	154Gd(n,g)155Gd	46	35
89Y(p,pn)88Y	22	15			

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Ti0887 Set

Note that the data given in the following Tables 2-4 from Ref. 2 are preliminary, and the cross-section set should be revised sometime to use the final data given in Tables 5-7, and add the new data in Tables 8-11, all from Ref. 3.

Table 2. $^{48}\text{Ti}(\text{p},\text{n})^{48}\text{V}$ Reaction. Preliminary data from Ref. 2.

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>
4.96	1.60	8.05	399.	17.0	205.
5.11	4.64	8.26	424.	18.0	155.
5.27	31.0	8.89	451.	19.0	115.
5.37	63.1	9.56	463.	20.0	89.
5.66	134.	10.82	508.	21.0	69.
5.86	171.	11.68	508.	22.0	57.
6.37	276.	13.51	503.	23.0	47.
6.94	309.	14.56	433.	24.0	41.
7.07	323.	15.29	350.	25.0	37.
7.48	366.	16.0	275.	26.0	34.

Table 3. $^{47}\text{Ti}(\text{d},\text{n})^{48}\text{V}$ Reaction. Preliminary data from Ref. 2. Note that the data for 8 MeV and higher are from K. Chen and J. Miller, Phys. Rev. B 134, 1269 (1964), quoted in Ref. 2.

<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>
1.85	1.20	3.56	136.4	7.10	261.
2.04	3.49	3.75	167.9	8.0	208.
2.24	7.53	3.82	190.1	9.8	122.5
2.43	15.9	4.24	227.	12.1	93.0
2.63	27.8	4.32	258.	14.0	70.1
2.83	47.3	4.85	271.	15.7	63.4
3.03	59.2	5.00	299.	17.6	51.9
3.21	83.2	5.83	296.	19.5	42.2
3.33	105.4	6.38	282.	20.5	42.0

Table 4. $^{48}\text{Ti}(\text{d},2\text{n})^{48}\text{V}$ Reaction. Preliminary data from Ref. 2.

<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>
7.60	6.1	10.41	194.5	15.50	432.
8.10	16.8	10.56	203.9	17.04	451.
8.23	22.4	11.00	264.	18.48	440.
8.69	55.7	11.75	289.	19.84	417.
9.26	95.9	12.49	351.		
9.74	163.5	14.29	414.		

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Table 5. $^{48}\text{Ti}(\text{p},\text{n})^{48}\text{V}$ Reaction. Final results from Ref. 3.

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>
4.96	1.60 +/- 0.17	7.48	366. +/- 11.	15.90	291. +/- 9.
5.11	4.64 +/- 0.48	8.05	399. +/- 12.	17.72	165. +/- 5.
5.27	31.0 +/- 1.0	8.26	424. +/- 13.	19.37	106. +/- 3.
5.37	63.1 +/- 2.0	8.89	451. +/- 14.	20.95	74.8 +/- 2.4
5.66	134. +/- 4.	9.56	463. +/- 14.	22.65	58.0 +/- 1.8
5.86	171. +/- 5.	10.82	508. +/- 15.	24.05	45.8 +/- 1.5
6.37	276. +/- 8.	11.68	508. +/- 15.	25.41	42.0 +/- 1.3
6.94	309. +/- 9.	13.20	504. +/- 16.	26.71	39.3 +/- 1.3
7.07	323. +/- 10.	15.00	371. +/- 12.		

Table 6. $^{47}\text{Ti}(\text{d},\text{n})^{48}\text{V}$ Reaction. Final results from Ref. 3. The data extend up to 34.6 MeV.

<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>
1.85	1.20 +/- 0.04	3.82	190. +/- 6.	9.35	177. +/- 5.
2.04	3.49 +/- 0.11	3.91	214. +/- 7.	10.70	128. +/- 4.
2.24	7.53 +/- 0.2	4.24	227. +/- 7.	11.92	115. +/- 4.
2.43	15.9 +/- 0.5	4.32	258. +/- 8.	13.04	96.3 +/- 3.0
2.63	27.8 +/- 0.9	4.85	271. +/- 9.	14.13	78.0 +/- 2.5
2.83	47.3 +/- 1.5	5.00	299. +/- 10.	15.16	68.9 +/- 2.2
3.03	59.2 +/- 1.9	5.83	296. +/- 9.	16.14	69.8 +/- 2.2
3.21	83.2 +/- 2.6	6.13	286. +/- 9.	17.06	61.8 +/- 1.9
3.33	105. +/- 3.	6.38	282. +/- 9.	17.94	57.0 +/- 1.8
3.56	136. +/- 4.	7.10	261. +/- 8.	21.94	45.7 +/- 1.5

3.75	168. +/- 5.	7.88	220. +/- 7.	23.47	41.9 +/- 1.3
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Table 7. $^{48}\text{Ti}(\text{d},2\text{n})^{48}\text{V}$ Reaction. Final results from Ref. 3. The data extend up to 34.6 MeV.

<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma</u>
(mb)					(mb)
7.46	0.666 +/- 0.021	9.74	162. +/- 5.	15.50	431. +/- 14.
7.60	3.70 +/- 0.12	10.01	165. +/- 5.	15.99	421. +/- 13.
7.82	5.43 +/- 0.17	10.56	203. +/- 6.	17.04	450. +/- 14.
8.10	15.50 +/- 0.49	10.86	230. +/- 7.	17.95	434. +/- 14.
8.23	19.85 +/- 0.63	11.00	264. +/- 8.	18.48	440. +/- 14.
8.24	19.35 +/- 0.61	11.75	287. +/- 9.	19.84	417. +/- 13.
8.69	53.6 +/- 1.7	11.95	303. +/- 10.	19.92	400. +/- 13.
8.84	58.1 +/- 1.8	12.49	348. +/- 11.	21.73	368. +/- 12.
9.26	93.9 +/- 3.	13.93	391. +/- 12.	23.35	318. +/- 10.
9.33	100. +/- 3.	14.29	412. +/- 13.	24.89	261. +/- 8.

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Table 8. $^{\text{Nat}}\text{Ti}(\text{t},\text{xn})^{48}\text{V}$ Reaction. Final results from Ref. 3. The data in column 2 were split into individual cross sections for the $^{46}\text{Ti}(\text{t},\text{n})^{48}\text{V}$ (col. 3) and $^{47}\text{Ti}(\text{t},2\text{n})^{48}\text{V}$ (col. 4) reactions using the results of Stapre calculations to scale the measured values.

<u>E_t(MeV)</u>	<u>Sigma(mb)</u>	<u>$^{46}\text{Ti}(\text{t},\text{n})^{48}\text{V}$</u>	<u>$^{47}\text{Ti}(\text{t},2\text{n})^{48}\text{V}$</u>
1.67	0.010 +/- 0.001	0.125	0.0
2.03	0.155 +/- 0.023	2.42	0.076
2.21	0.199 +/- 0.010	11.7	1.57
2.73	1.05 +/- 0.04	40.8	10.3
3.25	4.01 +/- 0.13	70.2	38.9
3.77	8.46 +/- 0.26	95.3	122.
4.59	16.5 +/- 0.5	83.0	340.
6.62	31.4 +/- 1.0	64.2	441.
8.13	37.3 +/- 1.1	51.1	499.
9.50	40.5 +/- 1.2	40.3	541.
10.91	42.8 +/- 1.3	30.6	540.
12.45	41.9 +/- 1.3	24.8	526.
13.88	40.4 +/- 1.3	20.1	494.
15.32	37.7 +/- 1.2	16.7	446.
16.54	33.9 +/- 1.3	13.7	387.
17.71	29.4 +/- 1.8	9.93	286.

Table 9. $^{48}\text{Ti}(\text{t},\text{a})^{47}\text{Sc}$ Reaction. Final results from Ref. 3.

<u>E_t(MeV)</u> (mb)	<u>Sigma</u> (mb)	<u>E_t(MeV)</u>	<u>Sigma</u> (mb)	<u>E_t(MeV)</u>	<u>Sigma</u>
1.67	0.014 +/- 0.001	3.77	9.59 +/- 0.3	9.50	55.1 +/- 1.7
2.04	0.152 +/- 0.008	4.28	15.8 +/- .5	10.30	53.1 +/- 1.7
2.21	0.27 +/- 0.01	4.59	18.2 +/- 0.6	12.47	44.3 +/- 1.4
2.60	1.14 +/- 0.04	5.73	28.7 +/- 0.9	13.61	40.3 +/- 1.3
2.73	1.56 +/- 0.05	6.63	37.1 +/- 1.2	15.19	34.2 +/- 1.0
3.08	3.71 +/- 0.12	7.23	42.5 +/- 1.3	16.55	33.1 +/- 1.0
3.25	4.79 +/- 0.15	8.15	48.4 +/- 1.5	17.83	32.6 +/- 1.0
3.62	8.21 +/- 0.26	8.87	50.6 +/- 1.6		

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Table 10. $^{47}\text{Ti}(\text{d},\text{an})^{44g, 44m}\text{Sc}$ Reaction. Final results from Ref. 3.

<u>E_d (MeV)</u>	<u>^{44g}Sc Sigma</u> (mb)	<u>^{44m}Sc Sigma</u> (mb)
9.35	0.036 +/- 0.010	0.004 +/- 0.007
10.70	0.50 +/- 0.03	0.277 +/- 0.016
11.92	4.6 +/- 0.14	2.35 +/- 0.07
11.92	4.17 +/- 0.14	2.60 +/- 0.1
13.04	12.8 +/- 0.4	7.35 +/- 0.2
14.13	22.0 +/- 0.7	12.1 +/- 0.4
15.16	32.7 +/- 0.9	17.3 +/- 0.5
16.14	44.8 +/- 1.5	23.6 +/- 0.7
17.06	52.8 +/- 1.5	26.4 +/- 0.8
17.94	58.4 +/- 1.8	30.2 +/- 0.9

Table 11. $^{46}\text{Ti}(\text{d},\text{a})^{44g, 44m}\text{Sc}$ Reaction. Final results from Ref. 3.

<u>E_d (MeV)</u>	<u>^{44g}Sc Sigma (mb)</u>	<u>^{44m}Sc Sigma (mb)</u>
4.85		1.01 +/- 0.1
5.06	19.8 +/- 0.7	1.99 +/- 0.14
5.36	23.9 +/- 0.8	2.38 +/- 0.1
5.92	31.6 +/- 1.1	2.95 +/- 0.14
6.38		3.35 +/- 0.2
7.67	48.5 +/- 1.6	6.91 +/- 0.3
8.10		7.38 +/- 0.4
9.20	62.0 +/- 2.1	11.9 +/- 0.7
9.74		13.5 +/- 0.5
10.41		12.9 +/- 0.5
10.54	63.4 +/- 2.0	15.1 +/- 0.6
11.00		15.1 +/- 0.6
11.51	57.7 +/- 2.0	16.9 +/- 0.7
11.75		15.1 +/- 0.7
12.49		16.8 +/- 0.7
13.37	46.4 +/- 2.0	15.9 +/- 0.8
14.29		15.9 +/- 1.1
15.10	33.0 +/- 2.1	14.1 +/- 1.1
16.63	23.5 +/- 2.6	10.2 +/- 1.2
18.26	19.0 +/- 4.0	6.9 +/- 1.4
19.83	17.0 +/- 6.0	6.9 +/- 2.9

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Cr0386 Set

The $^{50}\text{Cr}(\text{n},\text{t})^{48}\text{V}$ reaction is based on the average (0.0875 mb) of results given in Ref. 4 (0.066 mb) and in Ref. 5 (0.109 mb), both at 14.6 MeV. The $^{50}\text{Cr}(\text{n},\text{np})^{49}\text{V}$ reaction is based on a measurement given in Ref. 6 (405 +/- 65 mb at 14.7 MeV).

Table 12. $^{52}\text{Cr}(\text{p},\text{n})^{52g}\text{Mn}$ Reaction. Final results from Ref. 7.

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>
6.30	4.44	9.84	80.9	18.90	61.1
6.75	14.14	11.82	111.7	20.91	44.4
7.32	26.0	14.24	138.2	22.91	35.7
7.79	41.1	15.39	120.7	24.91	29.1
8.78	56.9	16.89	96.1	26.91	24.6

Table 13. $^{52}\text{Cr}(\text{d},2\text{n})^{52\text{g}}\text{Mn}$ Reaction. Final results from Ref. 7.

<u>E_d</u> (MeV)	<u>Sigma</u> (mb)	<u>E_d</u> (MeV)	<u>Sigma</u> (mb)	<u>E_d</u> (MeV)	<u>Sigma</u> (mb)
8.17	0.176	9.97	34.15	15.89	181.6
8.27	0.508	10.62	58.3	16.91	187.0
8.37	0.961	10.97	74.6	17.66	192.9
8.46	1.84	11.47	87.4	17.80	197.2
8.56	2.48	11.75	100.6	18.25	198.5
8.71	4.71	11.76	97.5	18.83	198.3
8.97	7.99	13.47	141.3	19.32	195.5
9.46	17.29	13.78	150.1	19.58	197.0
9.60	25.03	15.05	169.8	19.82	197.6
9.89	31.30	15.82	177.2		

Table 14. $^{50}\text{Cr}(\text{d},\text{a})^{48}\text{V}$ Reaction. Final results from Ref. 8.

<u>E_d</u> (MeV) (mb)	<u>Sigma</u> (mb)	<u>E_d</u> (MeV)	<u>Sigma</u> (mb)	<u>E_d</u> (MeV)	<u>Sigma</u>
4.59	9.2 +/- 0.16	8.97	51.3 +/- 0.6	13.47	53.5 +/- 3.4
4.64	8.78 +/- 0.17	9.46	54.1 +/- 0.7	14.90	40.8 +/- 3.5
5.78	19.3 +/- 0.6	9.60	61.8 +/- 3.0	15.05	40.6 +/- 4.5
6.97	31.9 +/- 1.0	9.62	59.8 +/- 4.0	15.89	34.4 +/- 1.0
7.64	38.2 +/- 0.45	9.89	57.8 +/- 1.4	16.91	30.9 +/- 6.2
8.17	41.2 +/- 0.7	9.97	60.4 +/- 1.4	17.66	25.1 +/- 0.7
8.27	43.4 +/- 0.8	10.62	64.4 +/- 3.3	18.25	25.8 +/- 5.0
8.37	44.6 +/- 0.8	10.97	62.4 +/- 2.2	18.83	26.0 +/- 3.5
8.46	48.1 +/- 0.3	11.47	61.5 +/- 3.3	19.32	22.8 +/- 0.7
8.56	47.5 +/- 0.7	11.76	63.0 +/- 3.2	19.58	20.2 +/- 3.2
8.71	50.7 +/- 0.3	12.89	57.3 +/- 3.5	19.82	17.1 +/- 3.9

Br0391 Set

Table 15. $^{79}\text{Br}(\text{p},\text{n})^{79}\text{Kr}$ Reaction. Final results from Ref. 9. The results in columns 2 and 5 were scaled down by the factor, 0.928, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_p</u> (MeV) (mb)	<u>Sigma</u> (mb)	<u>Scaled</u> (mb)	<u>E_p</u> (MeV)	<u>Sigma</u> (mb)	<u>Scaled</u>
2.48	0.26 +/- 0.02	0.24	9.54	634. +/- 19.	588.

2.80	2.22 +/- 0.04	2.06	10.06	693. +/- 21.	643.
3.17	8.18 +/- 0.05	7.59	10.27	670. +/- 20.	621.
3.47	19.6 +/- 0.9	18.2	10.41	700. +/- 21.	649.
3.94	47.2 +/- 1.4	43.8	10.98	735. +/- 22.	682.
4.53	91.5 +/- 2.8	84.9	11.09	704. +/- 21.	653.
4.88	120.3 +/- 3.6	111.6	11.37	704. +/- 21.	653.
5.55	188.0 +/- 5.6	174.4	11.74	726. +/- 22.	673.
6.29	308. +/- 9.	286.	12.29	684. +/- 21.	634.
6.87	360. +/- 11.	334.	12.36	670. +/- 20.	621.
6.99	402. +/- 12.	373.	12.96	585. +/- 18.	543.
7.05	402. +/- 12.	373.	13.53	502. +/- 15.	466.
8.10	520. +/- 16.	482.	14.35	379. +/- 11.	352.
8.36	545. +/- 16.	506.	14.66	345. +/- 10.	320.
9.06	607. +/- 18.	563.	15.65	238. +/- 7.	221.
9.11	628. +/- 19	583.	16.87	149.6 +/- 4.5	138.8

Table 16. $^{79}\text{Br}(\text{d},2\text{n})^{79}\text{Kr}$ Reaction. Final results from Ref. 9. The results in columns 2 and 5 were scaled down by the factor, 0.928, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_d (MeV)</u>	<u>Sigma</u> (mb)	<u>Scaled</u> (mb)	<u>E_d (MeV)</u>	<u>Sigma</u> (mb)	<u>Scaled</u>
(mb)					
5.04	0.64 +/- 0.11	0.59	9.44	574. +/- 17.	532.
5.09	1.20 +/- 0.20	1.11	9.77	606. +/- 18.	562.
5.19	3.39 +/- 0.35	3.14	9.85	627. +/- 19.	582.
5.50	20.2 +/- 0.65	18.7	10.27	619. +/- 19.	574.
5.51	21.3 +/- 0.6	19.8	10.87	720. +/- 22.	668.
5.93	57.5 +/- 1.7	53.3	11.86	722. +/- 22.	670.
6.05	69.3 +/- 2.1	64.3	12.24	806. +/- 24.	748.
6.23	91.7 +/- 2.8	85.1	13.20	805. +/- 24.	747.
6.53	159.7 +/- 4.8	148.1	13.27	805. +/- 24.	747.
6.85	200.3 +/- 6.0	185.8	13.55	841. +/- 25.	780.
7.32	261. +/- 8.	242.	14.46	817. +/- 25.	758.
7.55	317. +/- 10.	294.	14.57	883. +/- 27.	819.
7.76	341. +/- 10.	316.	15.64	842. +/- 25.	781.
8.67	484. +/- 15.	449.	16.75	850. +/- 26.	788.
9.36	576. +/- 17.	534.			

Table 17. $^{81}\text{Br}(\text{p},\text{n})^{81}\text{Kr}$ Reaction. Preliminary data from Ref. 10 (actually used in the Br0391 cross-section set) in columns 2 and 5, and final data from Ref. 9 (not used yet) in Columns 3 and 6.

Ref. 10	Ref. 9	Ref. 10	Ref. 9
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<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Sigma(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Sigma</u>
2.23	0.44	0.47 +/- 0.02	9.06	616.	660. +/- 26.
2.80	2.70	2.90 +/- 0.09	9.11		705. +/- 28.
3.17	8.07	8.66 +/- 0.35	9.54	656.	704. +/- 28.
3.94	41.9	45.0 +/- 1.8	10.06		724. +/- 29.
4.53	109.2	117.1 +/- 4.7	10.98	627.	617. +/- 25.
4.88	136.7	146.4 +/- 5.9	11.09		578. +/- 23.
5.55	196.	210. +/- 8.	12.29	404.	434. +/- 17.
6.29	335.	359. +/- 14.	12.36		401. +/- 16.
6.87	418.	448. +/- 18.	13.52	259.	278. +/- 11.
6.99		456. +/- 18.	14.35		193.3 +/- 7.7
7.05	400.	429. +/- 17.	15.65		125.4 +/- 5.0
8.10		579. +/- 23.	16.87		79.7 +/- 3.1
8.36	591.	634. +/- 25.			

Table 18. $^{81}\text{Br}(\text{d},2\text{n})^{81}\text{Kr}$ Reaction. Preliminary data from Ref. 10 (actually used in the Br0391 cross-section set) in columns 2 and 5, and final data from Ref. 9 (not used yet) in Columns 3 and 6.

	Ref. 10	Ref. 9		Ref. 10	Ref. 9
<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Sigma</u>
3.83		0.018 +/- 0.009	8.67	649.	691. +/- 28.
4.52		14.6 +/- 0.9	9.36		745. +/- 30.
4.76		32.8 +/- 1.5	9.44	722.	775. +/- 31.
4.95	43.2	42.5 +/- 1.7	9.85	779.	836. +/- 33.
5.05	59.6	60.4 +/- 2.4	10.27	784.	841. +/- 34.
5.19	76.5	79.5 +/- 3.2	10.87		880. +/- 35.
5.50	117.2	124.7 +/- 5.0	11.86	815.	875. +/- 35.
5.51	119.1	127.3 +/- 5.1	12.24		950. +/- 38.
5.93	178.6	191.6 +/- 7.7	13.27	913.	980. +/- 39.
6.23	231.	247. +/- 10.	13.55		965. +/- 39.
6.53	301.	322. +/- 13.	14.46		911. +/- 36.
6.85	356.	388. +/- 16.	14.57	964.	1034. +/- 41.
7.32	414.	444. +/- 18.	15.64		895. +/- 36.
7.55	477.	512. +/- 20.	16.75		876. +/- 35.

Table 19. $^{80}\text{Kr}(n,g)^{81}\text{Kr}$ Reaction. Final results from Ref. 11.

<u>E_n(keV)</u> (mb)	<u>Sigma(mb)</u>	<u>E_n(keV)</u>	<u>Sigma(mb)</u>	<u>E_n(keV)</u>	<u>Sigma</u>
5.0	457.6 +/- 137.5	37.5	249.7 +/- 7.1	130.0	139.4 +/- 2.8
6.0	418.9 +/- 102.6	40.0	284.7 +/- 7.0	140.0	144.2 +/- 3.5
7.0	506.9 +/- 81.6	42.5	257.0 +/- 6.3	150.0	95.7 +/- 5.2
8.0	438.7 +/- 66.9	45.0	206.3 +/- 6.1	160.0	103.2 +/- 9.2
9.0	361.6 +/- 56.1	47.5	209.3 +/- 6.3	170.0	115.2 +/- 9.6
10.0	369.9 +/- 37.3	50.0	204.2 +/- 5.3	180.0	111.6 +/- 9.5
12.0	357.0 +/- 26.8	55.0	224.4 +/- 4.7	196.1	117.6 +/- 11.6
14.0	417.7 +/- 21.1	60.0	191.4 +/- 4.4	199.8	115.4 +/- 11.0
16.0	370.8 +/- 16.0	65.0	169.2 +/- 3.9	203.6	119.2 +/- 10.8
18.0	353.2 +/- 14.3	70.0	172.3 +/- 3.8	207.5	104.2 +/- 10.9
20.0	350.1 +/- 16.2	75.0	166.9 +/- 3.9	211.6	89.0 +/- 10.9
22.0	357.8 +/- 14.1	80.0	146.8 +/- 3.7	215.7	92.0 +/- 10.6
24.0	336.9 +/- 11.8	85.0	160.1 +/- 3.6	220.0	104.1 +/- 10.9
26.0	347.7 +/- 10.5	90.0	152.2 +/- 3.6	224.4	99.5 +/- 10.7
28.0	302.9 +/- 10.5	95.0	142.5 +/- 4.0	229.0	105.5 +/- 11.0
30.0	308.1 +/- 8.6	100.0	149.5 +/- 3.1	233.7	97.9 +/- 11.3
32.5	249.6 +/- 7.8	110.0	143.4 +/- 2.8	238.5	95.7 +/- 11.5
35.0	269.5 +/- 8.2	120.0	141.9 +/- 2.6	243.0	96.2 +/- 11.8

Table 20. $^{78}\text{Kr}(n,2n)^{77}\text{Kr}$ and $^{80}\text{Kr}(n,2n)^{79}\text{Kr}$ Reactions. Final results from Ref. 12.

<u>E_n(MeV)</u>	<u>⁷⁸Kr Sigma(mb)</u>	<u>⁸⁰Kr Sigma(mb)</u>
13.975	233. +/- 9.	688.
14.415	321. +/- 26.	
14.44		797.
14.685		895. +/- 56.
14.70	376. +/- 11.	

Table 21. $^{78}\text{Kr}(\text{n},\text{g})^{79}\text{Kr}$ Reaction. Final results from Ref. 11.

<u>E_n</u> (keV) (mb)	<u>Sigma</u> (mb)	<u>E_n</u> (keV)	<u>Sigma</u> (mb)	<u>E_n</u> (keV)	<u>Sigma</u>
10.0	584. +/- 36.	47.5	395.3 +/- 6.6	150.0	284.5 +/- 3.4
12.0	514. +/- 32.	50.0	311.0 +/- 5.5	160.0	245.7 +/- 3.6
14.0	609. +/- 26.	55.0	333.1 +/- 4.8	170.0	171.6 +/- 3.9
16.0	489. +/- 21.	60.0	333.9 +/- 4.6	180.0	198.9 +/- 4.1
18.0	380. +/- 18.	65.0	292.2 +/- 4.5	196.1	176.2 +/- 5.3
20.0	514. +/- 16.	70.0	253.8 +/- 4.4	199.8	166.3 +/- 5.4
22.0	429. +/- 14.	75.0	260.3 +/- 4.3	203.6	132.1 +/- 5.4
24.0	413. +/- 13.	80.0	283.7 +/- 4.2	207.5	192.6 +/- 5.4
26.0	453. +/- 12.	85.0	221.8 +/- 4.0	211.6	235.0 +/- 5.3
28.0	395. +/- 11.	90.0	225.7 +/- 4.0	215.7	214.9 +/- 5.3
30.0	417. +/- 9.	95.0	202.4 +/- 3.9	220.0	195.7 +/- 5.2
32.5	496. +/- 8.	100.0	200.0 +/- 3.4	224.4	201.3 +/- 5.0
35.0	329. +/- 8.	110.0	187.4 +/- 3.1	229.0	155.1 +/- 4.8
37.5	236. +/- 7.	120.0	205.3 +/- 3.0	233.7	183.8 +/- 4.6
40.0	311. +/- 7.	130.0	178.8 +/- 3.1	238.5	216.1 +/- 4.3
42.5	368. +/- 7.	140.0	157.2 +/- 3.2	243.0	272.4 +/- 4.0
45.0	324. +/- 7.				

YT0488 Set

The $^{88\text{g},88\text{m}1,88\text{m}2}\text{Y}(\text{n},2\text{n})^{87\text{g}+87\text{m}}\text{Y}$ reactions are based on measurements cited in Ref. 13 made on $^{88\text{g}}\text{Y}$ at 14.19 MeV (1140 +/- 50 mb) and at 14.8 MeV (1180 +/- 50 mb). Note that the data given in Tables 25 and 26 from Ref. 15 are preliminary, and the cross-section set should be revised sometime to use the final data given in Tables 27 and 28 from Ref. 3.

Table 22. $^{89}\text{Y}(\text{p},\text{pn})^{88}\text{Y}$ Reaction. Final results from Ref. 14. (The data extend to 39.6 MeV.)

<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma</u>
12.70	0.0123 +/- 0.0030	14.95	8.39 +/- 0.32	19.21	115.2 +/- 3.4
13.30	0.096 +/- 0.016	15.41	17.87 +/- 0.55	19.89	128.4 +/- 3.7
13.40	0.151 +/- 0.038	15.95	31.20 +/- 0.93	19.92	129.8 +/- 4.2
13.80	0.272 +/- 0.108	16.57	45.2 +/- 1.3	20.87	146.4 +/- 4.2
14.19	1.21 +/- 0.13	17.39	64.8 +/- 1.9	20.91	156.6 +/- 4.5
14.68	5.31 +/- 0.54	18.31	85.9 +/- 2.9	21.44	163.9 +/- 4.9

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Table 23. $^{89}\text{Y}(\text{p},\text{n})^{89}\text{Zr}$ Reaction. Final results from Ref. 14. The measured cross sections, which are $\sigma(^{89}\text{g}\text{Zr}) + 0.938 * \sigma(^{89}\text{m}\text{Zr})$, have been split into two parts for the ^{89}g and ^{89}m states using the plot of measured isomer ratio vs. energy in Fig. 4 of Ref. 14. The data extend up to 39.6 MeV.

<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>^{89g}Zr Sigma(mb)</u>	<u>^{89m}Zr Sigma(mb)</u>
4.59	17.15 +/- 0.49	7.1	10.7
4.78	26.3 +/- 0.7	10.8	16.5
5.30	51.2 +/- 1.4	21.0	32.2
5.51	70.5 +/- 2.0	28.9	44.3
5.81	98.2 +/- 2.8	40.3	61.7
6.31	142.4 +/- 4.0	58.5	89.5
6.62	200. +/- 6.	82.0	126.2
6.83	224. +/- 6.	91.7	141.3
7.36	330. +/- 9.	135.1	208.0
7.90	391. +/- 11.	160.0	246.
8.38	467. +/- 13.	191.1	294.
8.98	521. +/- 15.	214.	327.
9.18	573. +/- 16.	236.	359.
9.88	617. +/- 17.	256.	385.
9.94	636. +/- 18.	265.	396.
10.87	675. +/- 19.	284.	416.
10.88	674. +/- 19.	284.	416.
11.97	742. +/- 21.	325.	444.
12.46	751. +/- 21.	346.	432.
12.70	749. +/- 21.	376.	398.
13.30	756. +/- 21.	417.	362.
13.40	769. +/- 22.	428.	364.
13.80	787. +/- 22.	454.	355.
14.19	765. +/- 22.	467.	317.

14.68	700. +/- 20.	470.	245.
14.95	666. +/- 19.	461.	219.
15.41	599. +/- 17.	424.	187.
15.95	536. +/- 15.	384.	162.
16.57	475. +/- 13.	342.	142.
17.39	321. +/- 9.	233.	94.
18.31	241.9 +/- 7.5	176.2	70.1
19.21	169.2 +/- 5.0	123.8	48.4
19.89	135.3 +/- 3.8	99.1	38.6
19.92	140.8 +/- 4.0	103.1	40.2
20.87	106.2 +/- 3.0	77.8	30.3
20.91	102.0 +/- 2.9	74.7	29.1

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Table 24. $^{89}\text{Y}(\text{p},2\text{n})^{88}\text{Zr}$ Reaction. Final results from Ref. 14. (The data extend to 39.6 MeV.)

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma</u>
(mb)					
13.30	3.62 +/- 0.14	15.41	229.6 +/- 6.9	19.89	726. +/- 21.
13.40	6.49 +/- 0.21	15.95	324.8 +/- 9.3	19.92	765. +/- 23.
13.80	34.9 +/- 1.0	16.57	418. +/- 12.	20.87	747. +/- 22.
14.19	70.0 +/- 2.0	17.39	534. +/- 15.	20.91	775. +/- 22.
14.68	125.2 +/- 3.6	18.31	644. +/- 21.	21.44	765. +/- 23.
14.95	165.9 +/- 4.8	19.21	711. +/- 21.	22.38	784. +/- 24.

Table 25. $^{89}\text{Y}(\text{d},2\text{n})^{89}\text{Zr}$ Reaction. Preliminary results from Ref. 15. The measured cross sections, which are $\sigma(^{89}\text{g}\text{Zr}) + 0.938 * \sigma(^{89}\text{m}\text{Zr})$, have been split into two parts for the 89g and 89m states using a calculated isomer ratio.

<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>^{89g}Zr Sigma (mb)</u>	<u>^{89m}Zr Sigma (mb)</u>
6.62	17.09	16.9	0.24
6.67	20.10	19.7	0.48
7.27	77.6	68.2	10.0
8.08	190.3	148.8	44.2
8.40	248.8	190.3	62.4
9.38	400.	301.	105.8
9.89	478.	363.	123.5

10.49	555.	426.	138.1
11.37	665.	522.	152.3
13.08	800.	651.	158.8
14.64	922.	771.	161.2
16.29	952.	814.	147.0
18.14	996.	879.	125.5
19.84	908.	824.	89.5
21.10	781.	723.	61.2
22.78	611.	583.	30.0
24.36	479.	468.	11.5
25.74	400.	392.	8.0

Table 26. $^{89}\text{Y}(\text{d},3\text{n})^{88}\text{Zr}$ Reaction. Preliminary results from Ref. 15.

<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>
16.29	0.611	24.36	506.	32.77	696.
18.14	20.8	25.74	601.	34.23	637.
19.84	92.4	27.57	686.	35.99	584.
21.10	214.5	29.29	695.	37.73	510.
22.78	371.	31.13	718.	39.41	431.

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Table 27. $^{89}\text{Y}(\text{d},2\text{n})^{89}\text{Zr}$ Reaction. Final results from Ref. 3. The measured cross sections are sigma($^{89}\text{g}\text{Zr}$) + 0.938*sigma($^{89}\text{m}\text{Zr}$).

<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma</u>
<u>(mb)</u>					
6.62	15.88 +/- 0.50	14.64	922. +/- 29.	25.74	400. +/- 14.
6.67	19.9 +/- 0.6	15.97	982. +/- 31.	27.57	231.4 +/- 8.1
7.27	77.3 +/- 2.3	16.29	952. +/- 41.	29.29	262.8 +/- 8.2
8.08	190.1 +/- 5.8	16.67	945. +/- 41.	31.13	225.0 +/- 8.2
8.40	248.7 +/- 7.5	17.50	952. +/- 41.	32.77	197.0 +/- 6.3
9.38	400. +/- 12.	18.14	976. +/- 43.	34.23	180.0 +/- 5.6
9.89	479. +/- 14.	19.84	908. +/- 39.	35.99	160.9 +/- 5.3
10.49	555. +/- 17.	21.10	781. +/- 34.	37.73	145.6 +/- 5.9
11.37	665. +/- 21.	22.78	611. +/- 27.	39.41	133.6 +/- 4.5
13.08	800. +/- 25.	24.36	479. +/- 15.		

Table 28. $^{89}\text{Y}(\text{d},3\text{n})^{88}\text{Zr}$ Reaction. Final results from Ref. 3.

<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma</u>
<u>(mb)</u>					
15.99	0.071 +/- 0.020	21.10	211.4 +/- 8.6	31.13	711. +/- 22.
16.29	0.521 +/- 0.030	22.78	371. +/- 12.	32.77	689. +/- 21.
16.67	1.67 +/- 0.06	24.36	499. +/- 15.	34.23	632. +/- 19.
17.50	9.18 +/- 0.35	25.74	596. +/- 19.	35.99	579. +/- 18.
18.14	20.6 +/- 0.7	27.57	676. +/- 21.	37.73	506. +/- 16.
19.84	91.6 +/- 2.8	29.29	687. +/- 21.	39.41	426. +/- 13.

Table 29. $^{89}\text{Y}(n,2n)^{88}\text{Y}$ Reaction. These data are from Ref. 16, and are probably the most accurate measurements available for this reaction.

<u>E_n (MeV)</u>	<u>Sigma (mb)</u>	<u>E_n (MeV)</u>	<u>Sigma (mb)</u>
13.586 +/- 0.010	698. +/- 9.	14.476 +/- 0.012	936. +/- 13.
14.132 +/- 0.010	868. +/- 11.	14.789 +/- 0.014	1012. +/- 12.

Zr0982 Set

The $^{88}\text{Zr}(n,2n)^{87}\text{Zr}$ reaction is based on a measurement given in Ref. 13 (467 +/- 23 mb at 14.8 MeV). The $^{88}\text{Zr}(n,np)^{87}\text{Y}$ reaction is based on a measurement given in Ref. 13 (253 +/- 25 mb at 14.8 MeV). The $^{89}\text{Zr}(n,2n)^{88}\text{Zr}$ reaction is based on measurements given in Ref. 17 at 14.39 MeV (790 +/- 40 mb), 14.47 MeV (861 +/- 43 mb), and at 15.01 MeV (878 +/- 44 mb).

Table 30. $^{90}\text{Zr}(n,2n)^{89}\text{Zr}$ Reaction. These data are from an evaluation of experimental data given in Ref. 18 (which is by far the best available evaluation). The evaluated cross sections in column 2 ($^{89g}\text{Zr} + ^{89m}\text{Zr}$) have been split into two parts for the $89g$ and $89m$ states using the calculated isomer ratios from the cross-section set. The indicated neutron energies are the average energies of the bins used to sort the data.

<u>E_n (MeV)</u>	<u>Sigma (mb)</u>	<u>^{89g}Zr Sigma (mb)</u>	<u>^{89m}Zr Sigma (mb)</u>
12.30	26.3 +/- 4.0	26.26	0.0
12.55	82.3 +/- 8.8	82.35	0.0
13.00	247.6 +/- 12.5	245.1	2.52
13.40	392.0 +/- 6.8	368.5	23.5
13.60	461.4 +/- 8.8	425.0	36.4
13.80	535.5 +/- 7.0	482.8	52.7
14.00	591.3 +/- 6.4	521.0	70.3
14.20	652.3 +/- 8.9	561.5	90.8
14.40	717.8 +/- 6.8	607.7	110.1
14.60	763.8 +/- 10.4	639.1	124.7
14.80	805.1 +/- 8.0	665.8	139.3
15.15	901. +/- 22.	732.0	169.
16.00	1017. +/- 26.	805.	212.
17.15	1125. +/- 32.	885.	240.
18.35	1189. +/- 29.	962.	227.
20.00	1200. +/- 30.	1000.	200.

II0391 Set

Note that the data in Tables 31 and 32 are as used in the cross-section set. However, the cross sections should be lowered sometime by the factor, 0.984, to correct to the photon abundances used in Test program measurements.

Table 31. $^{127}\text{I}(\text{p},\text{n})^{127}\text{Xe}$ Reaction. Final results from Ref. 6.

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma</u>
(mb)					(mb)
3.35	0.126 +/- 0.006	8.02	216. +/- 7.	12.19	261. +/- 8.
3.80	0.482 +/- 0.018	8.10	251. +/- 8.	12.98	196.0 +/- 5.9
4.53	3.43 +/- 0.11	8.68	330. +/- 10.	13.02	191.1 +/- 6.0
5.11	7.90 +/- 0.26	8.90	384. +/- 12.	13.82	141.1 +/- 4.3
5.70	28.4 +/- 0.9	9.09	394. +/- 12.	14.25	118.3 +/- 3.6
6.12	48.6 +/- 1.5	9.65	435. +/- 13.	14.59	101.5 +/- 3.1
6.67	87.4 +/- 2.6	10.41	419. +/- 13.	15.53	81.0 +/- 2.4
7.12	108.4 +/- 3.3	11.30	337. +/- 10.	16.84	57.9 +/- 1.8
7.63	195.4 +/- 5.9				

Table 32. $^{127}\text{I}(\text{d},2\text{n})^{127}\text{Xe}$ Reaction. Final results from Ref. 6.

<u>E_d (MeV)</u>	<u>Sigma</u> (mb)	<u>E_d (MeV)</u>	<u>Sigma</u> (mb)	<u>E_d (MeV)</u>	<u>Sigma</u>
(mb)			<th></th> <td></td>		
4.19	0.020 +/- 0.002	7.33	147.8 +/- 4.5	10.98	715. +/- 22.
4.21	0.026 +/- 0.004	7.53	163.0 +/- 4.9	11.67	779. +/- 23.
4.54	0.256 +/- 0.057	8.10	250. +/- 8.	12.73	853. +/- 26.
4.86	0.92 +/- 0.03	8.39	322. +/- 10.	13.13	882. +/- 27.
5.24	3.82 +/- 0.15	8.56	361. +/- 11.	14.38	889. +/- 27.
5.54	9.67 +/- 0.31	9.51	479. +/- 14.	14.55	883. +/- 27.
6.40	44.5 +/- 1.4	9.94	581. +/- 18.	15.73	772. +/- 23.
6.75	71.5 +/- 2.2	10.43	616. +/- 19.	16.79	677. +/- 20.

Table 33. $^{127}\text{I}(\text{n},\text{g})^{128}\text{I}$ Reaction. Final results from Ref. 19.

<u>E_n (keV)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u> (mb)
3.5	1845.	175.	213.	1050.	73.6
5.0	1522.	250.	170.	1150.	71.0
7.0	1303.	350.	137.	1250.	72.3
9.0	1221.	450.	123.	1350.	65.8
12.5	1018.	550.	116.	1450.	66.7
17.5	858.	650.	106.	1550.	68.2
25.0	751.	713.	98.5	1650.	66.5
35.0	622.	738.	95.8	1750.	56.8
50.0	518.	763.	92.2	1850.	56.4
70.0	400.	788.	80.3	1950.	57.2
90.0	322.	850.	78.2	2050.	55.0
125.	260.	950.	73.5	2150.	52.3

Table 34. $^{127}\text{I}(\text{n},\text{g})^{128}\text{I}$ Reaction. Final results from Ref. 20. The data were visually taken from a plot of experimental data, replotted, and read from that plot.

<u>E_n (MeV)</u>	<u>Sigma</u> (mb)	<u>E_n (MeV)</u>	<u>Sigma</u> (mb)	<u>E_n (MeV)</u>	<u>Sigma</u> (mb)
2.5	32.7	6.0	7.6	12.0	3.15
3.0	22.1	7.0	6.16	14.0	2.62

3.5	17.0	8.0	5.20	16.0	2.25
4.0	13.7	9.0	4.46	20.0	1.74
5.0	9.8	10.0	3.92		

Eu0988 Set

The $^{151}\text{Eu}(n,2n)^{150}\text{Eu}$ and $^{153}\text{Eu}(n,2n)^{152}\text{Eu}$ reactions are based on an evaluation in Ref. 24. Cross sections for the ^{151}Eu reaction were scaled down by the factor, 0.911, to match the measured total ($n,2n$) cross section, 1.798 b at 14.8 MeV. Cross sections for the ^{153}Eu reaction are in agreement with the measured value, 2.05 ± 0.14 b at 14.7 MeV.²⁵

Table 35. $^{151}\text{Eu}(p,n)^{151}\text{Gd}$ Reaction. Preliminary results from Refs. 16 and 17. The results in columns 2 and 5 were scaled up by the factor, 1.216, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled</u>
(mb)					
5.49	6.47	7.87	8.21	128.2	155.9
5.70	7.47	9.08	8.47	149.3	181.5
6.02	11.97	14.56	9.29	187.3	227.8
6.10	13.97	16.99	9.52	186.5	226.8
6.38	19.51	23.72	10.09	196.5	238.9
6.63	30.7	37.4	10.29	189.2	230.1
6.92	42.7	51.9	10.48	180.2	219.1
7.16	55.6	67.6	10.95	184.4	224.2
7.85	99.4	120.9	11.58	149.0	181.1

Table 36. $^{151}\text{Eu}(d,2n)^{151}\text{Gd}$ Reaction. Preliminary results from Refs. 15 and 17. The results in columns 2 and 5 were scaled up by the factor, 1.216, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>
4.84	0.178	0.216	8.03	133.2	162.0
5.88	5.29	6.43	8.24	155.7	189.3
5.91	4.98	6.06	8.89	241.9	294.2
6.37	13.98	17.00	9.37	295.4	359.
6.74	25.78	31.35	9.81	326.	397.
7.22	68.3	83.1	10.22	392.	476.
7.60	81.6	99.2	10.35	419.	510.
7.99	118.8	144.5	11.18	528.	642.

Table 37. $^{153}\text{Eu}(\text{p},\text{n})^{153}\text{Gd}$ Reaction. Preliminary results from Refs. 16 and 17. The results in columns 2 and 5 were scaled down by the factor, 0.861, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled</u>
<u>(mb)</u>					
5.49	8.70	7.49	8.21	160.1	137.9
5.70	10.18	8.77	8.47	182.6	157.3
6.02	16.37	14.10	9.29	198.3	170.8
6.10	19.06	16.42	9.52	208.0	179.2
6.38	25.50	21.97	10.09	214.5	184.8
6.63	41.3	35.6	10.29	194.6	167.6
6.92	57.5	49.5	10.48	191.1	164.6
7.16	74.0	63.7	10.95	183.1	157.7
7.85	131.0	112.8	11.58	163.2	140.6

Table 38. $^{153}\text{Eu}(\text{d},2\text{n})^{153}\text{Gd}$ Reaction. Preliminary results from Refs. 15 and 17. The results in columns 2 and 5 were scaled down by the factor, 0.861, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6.

<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>	<u>E_d(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>
4.84	0.308	0.265	8.03	177.9	153.2
5.88	7.93	6.83	8.24	208.7	179.8
5.91	7.31	6.30	8.89	319.9	275.6
6.37	20.18	17.38	9.37	379.	326.5
6.74	36.6	31.5	9.81	426.	367.
7.22	92.7	79.9	10.22	511.	440.
7.60	112.6	97.0	10.35	540.	465.
7.99	160.2	138.0	11.18	670.	577.

Table 39. $^{151}\text{Eu}(\text{p},\text{n})^{151}\text{Gd}$ Reaction. Final results from Ref. 3. The results in columns 2 and 5 were scaled up by the factor, 1.216, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6. (The data extend up to 35.5 MeV.)

<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled(mb)</u>	<u>E_p(MeV)</u>	<u>Sigma(mb)</u>	<u>Scaled</u>
<u>(mb)</u>					
4.72	1.62 +/- 0.06	1.97	12.03	131.0 +/- 4.0	159.3
5.50	6.44 +/- 0.20	7.83	13.28	93.5 +/- 3.1	113.7
5.71	7.40 +/- 0.23	9.00	13.61	81.8 +/- 2.5	99.5
5.91	11.54 +/- 0.36	14.03	13.66	84.9 +/- 2.5	103.2
6.03	11.98 +/- 0.37	14.57	14.44	64.4 +/- 2.0	78.3
6.12	15.5 +/- 0.5	18.8	14.62	61.9 +/- 1.9	75.3
6.38	20.3 +/- 0.6	24.7	14.81	56.7 +/- 1.7	68.9
6.42	24.9 +/- 0.9	30.3	15.05	52.2 +/- 1.6	63.5
6.63	30.5 +/- 1.0	37.1	15.71	45.1 +/- 1.4	54.8
6.93	42.7 +/- 1.5	51.9	15.91	42.2 +/- 1.3	51.3
7.17	54.8 +/- 1.8	66.6	16.38	38.0 +/- 1.2	46.2
7.44	66.4 +/- 2.1	80.7	16.78	37.6 +/- 1.2	45.7
7.85	98.9 +/- 3.0	120.3	16.89	35.6 +/- 1.1	43.3
8.20	128.2 +/- 4.0	155.9	17.79	34.0 +/-	41.3
8.48	151.0 +/- 4.8	183.6	17.93	33.7 +/-	41.0
8.82	168.4 +/- 5.4	204.8	18.15	33.1 +/-	40.3
9.29	190.9 +/- 6.1	232.1	18.77	31.3 +/-	38.1
10.10	195.9 +/- 6.1	238.2	19.30	30.2 +/-	36.7
10.30	192.5 +/- 6.0	234.1	19.70	29.4 +/-	35.8
10.48	186.2 +/- 5.8	226.4	19.93	29.1 +/-	35.4
10.65	185.4 +/- 5.7	225.5	20.42	28.3 +/-	34.4
10.95	169.1 +/- 5.5	205.6	21.05	27.8 +/-	33.8
11.58	152.8 +/- 5.0	185.8	21.50	26.8 +/-	32.6

Table 40. $^{151}\text{Eu}(\text{d},2\text{n})^{151}\text{Gd}$ Reaction. Final results from Ref. 3. The results in columns 2 and 5 were scaled up by the factor, 1.216, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6. (The data extend up to 33.3 MeV.)

<u>$E_{\text{d}} (\text{MeV})$</u>	<u>Sigma (mb)</u>	<u>Scaled (mb)</u>	<u>$E_{\text{d}} (\text{MeV})$</u>	<u>Sigma (mb)</u>	<u>Scaled</u>
(mb)					
4.86	0.26 +/- 0.03	0.32	12.32	589. +/- 18.	716.
5.90	5.46 +/- 0.18	6.64	12.72	624. +/- 19.	759.
5.92	5.10 +/- 0.18	6.20	13.06	622. +/- 19.	754.
6.39	14.19 +/- 0.46	17.26	14.14	624. +/- 19.	759.
6.75	26.04 +/- 0.80	31.66	14.19	621. +/- 19.	756.
7.26	68.8 +/- 2.1	83.6	14.40	588. +/- 18.	715.
7.61	81.1 +/- 2.5	98.6	15.46	549. +/- 17.	667.
8.03	135.3 +/- 4.1	164.5	15.64	531. +/- 16.	646.
8.28	154.9 +/- 4.7	188.4	16.69	459. +/- 15.	558.
8.91	241.7 +/- 7.3	293.9	16.80	437. +/- 13.	531.
9.38	293.0 +/- 8.8	356.3	17.94	361. +/- 12.	439.
9.81	360. +/- 11.	438.	19.06	298. +/- 9.	362.
10.22	392. +/- 12.	476.	19.34	284. +/- 9.	345.
10.35	419. +/- 13.	510.	20.87	231. +/- 7.	281.
11.18	522. +/- 16.	634.	22.30	187. +/-	227.
11.35	518. +/- 17.	629.	23.64	163. +/-	198.

Table 41. $^{153}\text{Eu}(\text{p},\text{n})^{153}\text{Gd}$ Reaction. Final results from Ref. 3. The results in columns 2 and 5 were scaled down by the factor, 0.861, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6. (The data extend up to 35.5 MeV.)

<u>$E_{\text{p}} (\text{MeV})$</u>	<u>Sigma (mb)</u>	<u>Scaled (mb)</u>	<u>$E_{\text{p}} (\text{MeV})$</u>	<u>Sigma (mb)</u>	<u>Scaled</u>
(mb)					
4.72	2.35 +/- 0.07	2.02	12.03	148.4 +/- 4.5	127.7
5.50	8.92 +/- 0.27	7.68	13.28	101.0 +/- 3.1	87.0
5.71	10.20 +/- 0.31	8.78	13.61	90.6 +/- 2.8	78.0
5.91	16.30 +/- 0.49	14.03	13.66	90.9 +/- 2.7	78.3
6.03	16.56 +/- 0.51	14.26	14.44	71.5 +/- 2.2	61.6
6.12	21.1 +/- 0.6	18.2	14.62	68.3 +/- 2.1	58.8
6.38	27.9 +/- 0.9	24.0	14.81	62.6 +/- 1.9	53.9
6.42	34.5 +/- 1.0	29.7	15.05	58.6 +/- 1.8	50.5
6.63	41.8 +/- 1.3	36.0	15.71	51.1 +/- 1.5	44.0
6.93	58.2 +/- 1.7	50.1	15.91	47.7 +/- 1.4	41.1
7.17	74.3 +/- 2.2	64.0	16.38	45.1 +/- 1.4	38.8

7.44	92.6 +/- 2.8	79.7	16.78	42.9 +/- 1.3	36.9
7.85	129.7 +/- 3.9	111.7	16.89	40.2 +/- 1.2	34.6
8.20	160.1 +/- 4.8	137.8	17.79	38.7 +/- 1.3	33.3
8.48	185.1 +/- 5.6	159.4	17.93	36.3 +/- 1.2	31.3
8.82	202.0 +/- 6.9	173.9	18.15	35.3 +/- 1.2	30.4

(continued on next page)

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Table 41, continued.

<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>Scaled (mb)</u>	<u>E_p (MeV)</u>	<u>Sigma (mb)</u>	<u>Scaled (mb)</u>
9.29	215.4 +/- 6.5	185.5	18.77	35.2 +/- 1.1	30.3
10.10	212.0 +/- 6.4	182.5	19.30	34.8 +/- 1.1	30.0
10.30	208.1 +/- 6.2	179.2	19.70	33.9 +/- 1.1	29.2
10.48	191.1 +/- 5.8	164.5	19.93	32.2 +/- 1.1	27.7
10.65	200.2 +/- 6.0	172.4	20.42	32.3 +/- 1.1	27.8
10.95	187.1 +/- 5.8	161.1	21.05	31.3 +/- 1.7	26.9
11.58	170.3 +/- 5.3	146.6	21.50	30.4 +/- 1.1	26.2

Table 42. $^{153}\text{Eu}(\text{d},2\text{n})^{153}\text{Gd}$ Reaction. Final results from Ref. 3. The results in columns 2 and 5 were scaled down by the factor, 0.861, to correct to the photon abundances in use for Test Program measurements, and are given in columns 3 and 6. (The data extend up to 33.3 MeV.)

<u>E_d (MeV) (mb)</u>	<u>Sigma (mb)</u>	<u>Scaled (mb)</u>	<u>E_d (MeV)</u>	<u>Sigma (mb)</u>	<u>Scaled</u>
4.86	0.39 +/- 0.02	0.34	12.32	754. +/- 23.	649.
5.90	8.01 +/- 0.25	6.90	12.72	766. +/- 23.	660.
5.92	7.38 +/- 0.23	6.35	13.06	812. +/- 24.	699.
6.39	20.35 +/- 0.63	17.52	14.14	728. +/- 22.	627.
6.75	36.6 +/- 1.1	31.5	14.19	749. +/- 23.	645.
7.26	93.6 +/- 2.8	80.6	14.40	694. +/- 21.	598.
7.61	111.6 +/- 3.4	96.1	15.46	619. +/- 19.	533.
8.03	180.8 +/- 5.5	155.7	15.64	609. +/- 18.	524.
8.28	205.7 +/- 6.2	177.1	16.69	496. +/- 15.	427.
8.91	318. +/- 10.	273.7	16.80	485. +/- 15.	418.
9.38	380. +/- 11.	327.	17.94	398. +/- 12.	343.
9.81	470. +/- 14.	405.	19.06	327. +/- 10.	282.
10.22	511. +/- 15.	440.	19.34	307. +/- 9.	264.
10.35	545. +/- 16.	469.	20.87	248. +/- 7.	214.
11.18	669. +/- 20.	576.	22.30	200. +/- 6.	172.
11.35	694. +/- 21.	597.	23.64	175. +/- 5.	151.

Table 43. $^{151}\text{Eu}(n,g)^{152}\text{Eu}$ Reaction. Final results from Ref. 23. The indicated neutron energies are the average energies of the bins used to sort the data.

<u>E_n(MeV)</u>	<u>Sigma (mb)</u>	<u>E_n(MeV)</u>	<u>Sigma (mb)</u>	<u>E_n(MeV)</u>	<u>Sigma (mb)</u>
0.0035	14620.	0.175	1412.	1.05	377.
0.0050	11570.	0.25	1224.	1.15	338.
0.0070	8990.	0.35	884.	1.25	319.
0.0090	7520.	0.45	711.	1.35	287.
0.0125	6106.	0.55	637.	1.45	262.
0.0175	4805.	0.65	547.	1.55	247.
0.025	3722.	0.7125	503.	1.65	232.
0.035	2851.	0.7375	502.	1.75	227.
0.050	2320.	0.7625	482.	1.85	196.
0.070	1939.	0.7875	473.	1.95	199.
0.090	1717.	0.85	439.	2.05	164.
0.125	1551.	0.95	399.	2.15	155.

Table 44. $^{153}\text{Eu}(n,g)^{154}\text{Eu}$ Reaction. Final results from Ref. 23. The indicated neutron energies are the average energies of the bins used to sort the data.

<u>E_n(MeV)</u>	<u>Sigma (mb)</u>	<u>E_n(MeV)</u>	<u>Sigma (mb)</u>	<u>E_n(MeV)</u>	<u>Sigma (mb)</u>
0.0035	8320.	0.175	916.	1.05	250.
0.0050	6480.	0.25	683.	1.15	229.
0.0070	5210.	0.35	500.	1.25	214.
0.0090	4597.	0.45	429.	1.35	202.
0.0125	3837.	0.55	411.	1.45	188.
0.0175	3168.	0.65	378.	1.55	183.
0.025	2597.	0.7125	349.	1.65	174.
0.035	2219.	0.7375	336.	1.75	163.
0.050	1914.	0.7625	324.	1.85	151.
0.070	1668.	0.7875	326.	1.95	156.

0.090	1491.	0.85	299.	2.05	128.
0.125	1189.	0.95	284.	2.15	126.

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Table 45. $^{152}\text{Gd}(n,g)^{153}\text{Gd}$ Reaction. Final results from Ref. 26. The indicated neutron energies are the average energies of the bins used to sort the data.

<u>E_n (keV) (mb)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u>
3.5	3400. +/- 100.	25.	1008. +/- 29.	175.	538. +/- 18.
5.0	2730. +/- 80.	35.	905. +/- 26.	250.	531. +/- 18.
7.0	2246. +/- 66.	50.	784. +/- 23.	350.	461. +/- 16.
9.0	1785. +/- 52.	70.	658. +/- 20.	450.	398. +/- 14.
12.5	1426. +/- 42.	90.	622. +/- 19.	550.	393. +/- 16.
17.5	1186. +/- 35.	125.	569. +/- 18.	650.	390. +/- 16.

Table 46. $^{154}\text{Gd}(n,g)^{155}\text{Gd}$ Reaction. Final results from Ref. 26. The indicated neutron energies are the average energies of the bins used to sort the data.

<u>E_n (keV) (mb)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u> (mb)	<u>E_n (keV)</u>	<u>Sigma</u>
3.5	2818. +/- 82.	25.	914. +/- 27.	175.	393. +/- 13.
5.0	2196. +/- 64.	35.	771. +/- 23.	250.	337. +/- 11.
7.0	1692. +/- 49.	50.	682. +/- 20.	350.	302. +/- 10.
9.0	1640. +/- 48.	70.	591. +/- 18.	450.	292. +/- 10.
12.5	1239. +/- 36.	90.	560. +/- 17.		
17.5	1044. +/- 30.	125.	486. +/- 16.		

The reactions in this set are all based on calculated excitation functions. The cross section for the $^{173}\text{Lu}(\text{n},2\text{n})^{172}\text{Lu}$ reaction is within 1% of the measured value, 2.05 ± 0.10 b at 14.8 MeV,²⁷ while that for the $^{175}\text{Lu}(\text{n},2\text{n})^{174}\text{Lu}$ reaction is within 5% of evaluated data near 14 MeV.

Bi0389 Set

The reactions in this set are all based on calculated excitation functions. The cross section for the $^{209}\text{Bi}(\text{n},2\text{n})^{208}\text{Bi}$ reaction at 14.9 MeV is 1.066 times the measured value at that energy, 2.20 ± 0.05 b.²⁸

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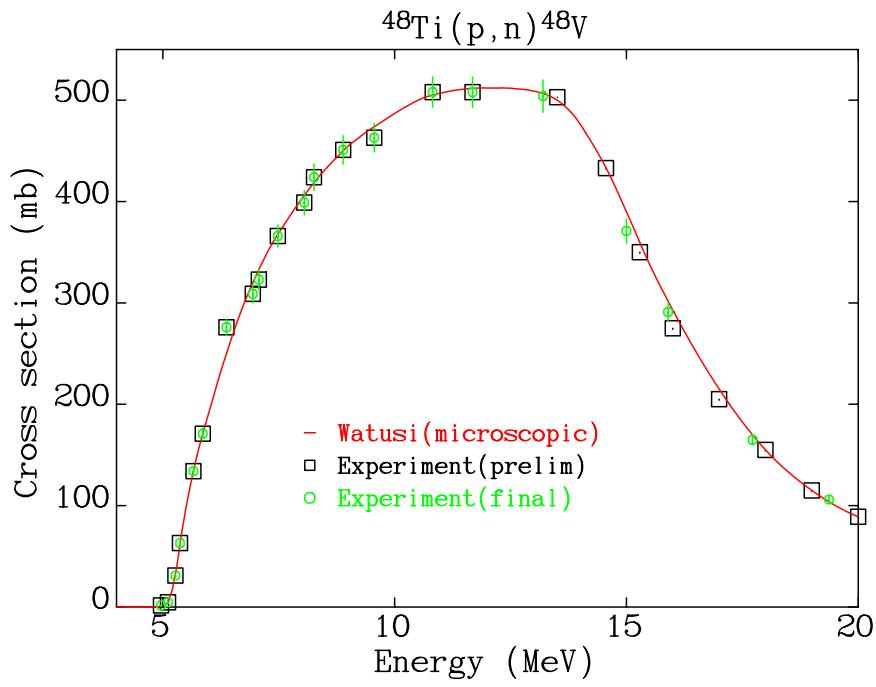


Fig. 1. $^{48}\text{Ti}(\text{p},\text{n})^{48}\text{V}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 2) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 5). Note that the two sets of data are identical below 12 MeV and have negligible difference above that energy.

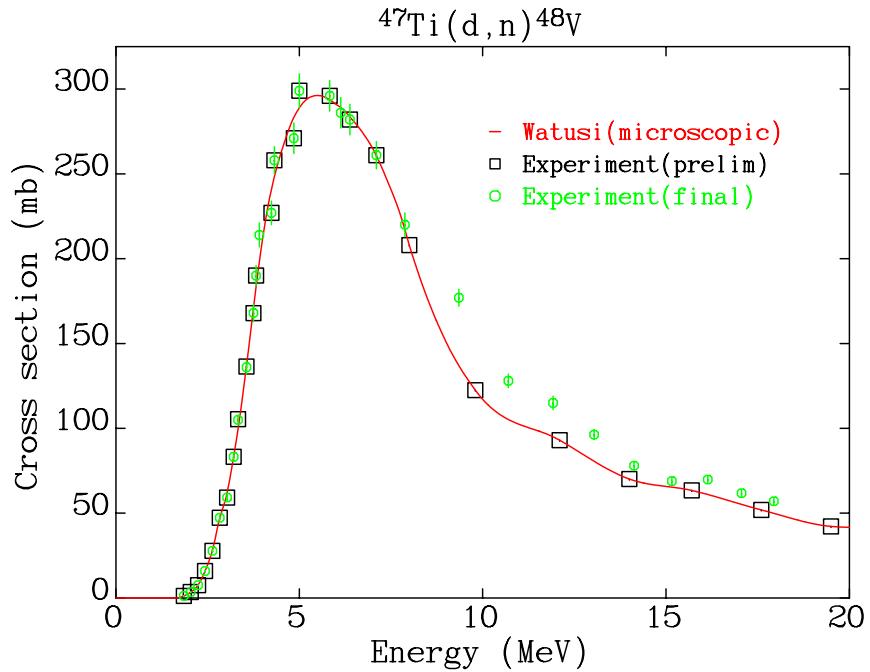


Fig. 2. $^{47}\text{Ti}(\text{d},\text{n})^{48}\text{V}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 3) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 6). Note that the two sets of data are identical below 7 MeV. The Watusi cross sections above 8 MeV will need revision.

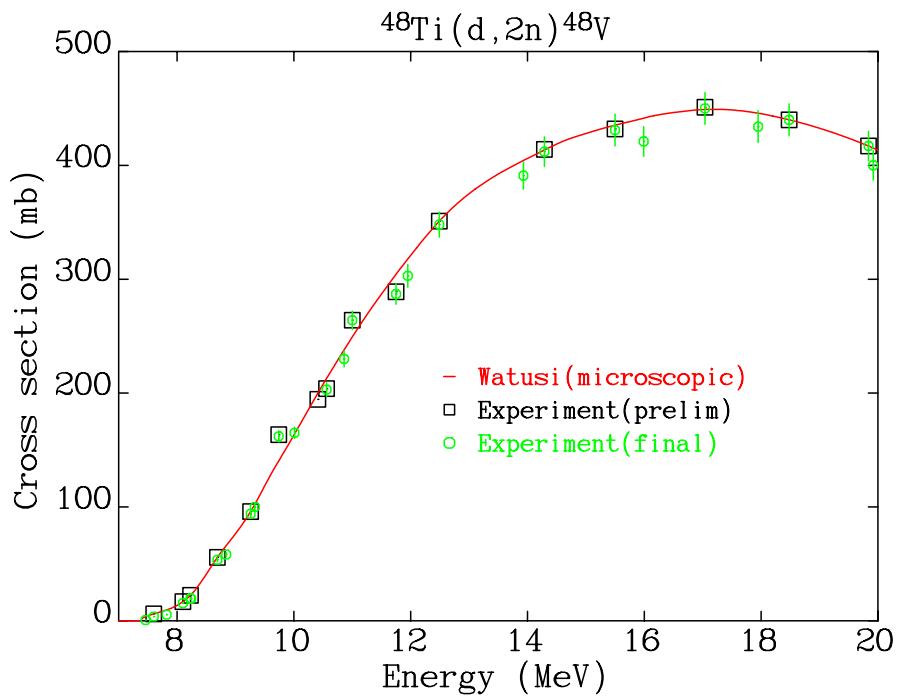


Fig. 3. $^{48}\text{Ti}(\text{d}, 2\text{n})^{48}\text{V}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 4) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 7). Note that the Watusi cross sections above 12 MeV will need revision.

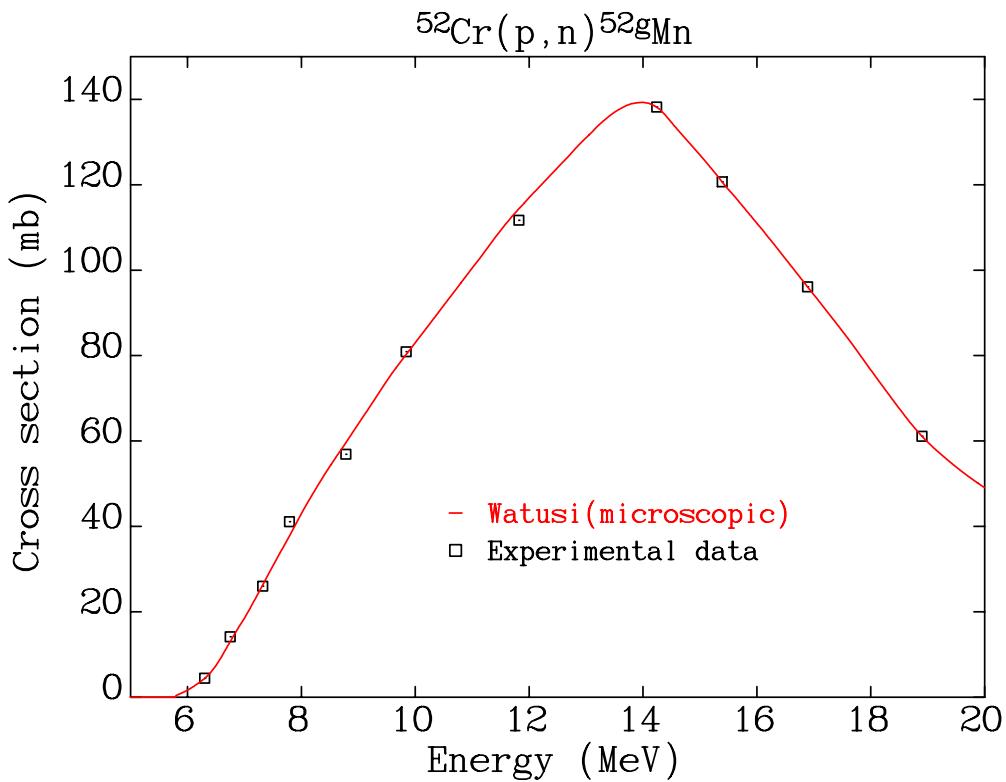


Fig. 4. $^{52}\text{Cr}(\text{p}, \text{n})^{52g}\text{Mn}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 12).

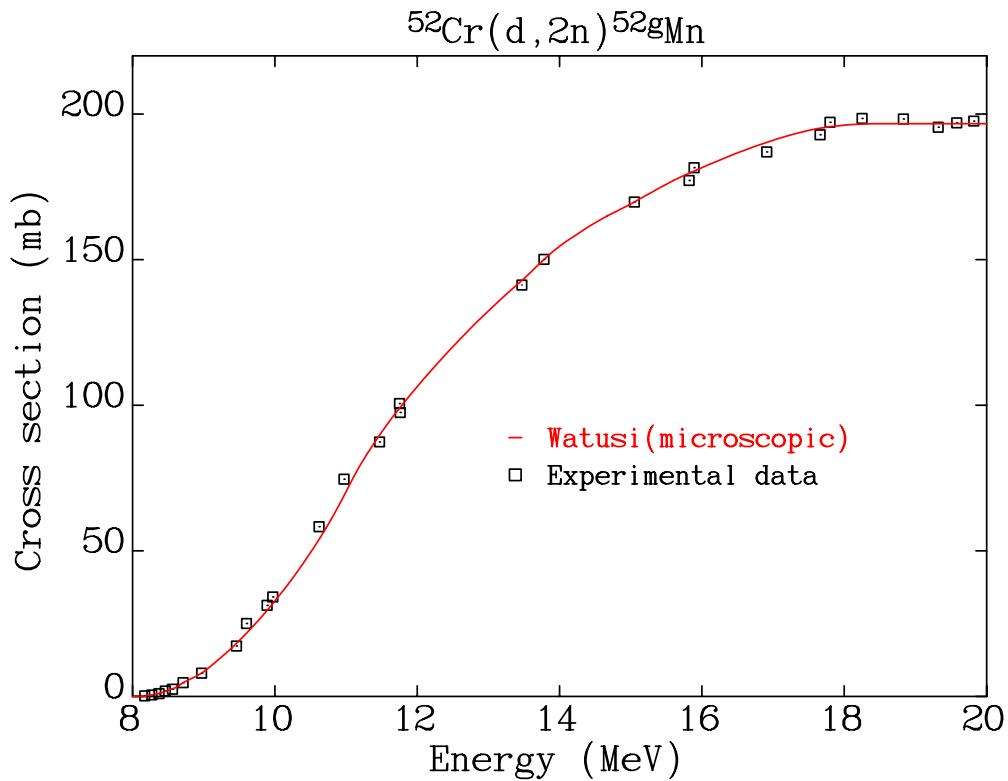


Fig. 5. $^{52}\text{Cr}(\text{d}, 2\text{n})^{52\text{g}}\text{Mn}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 13).

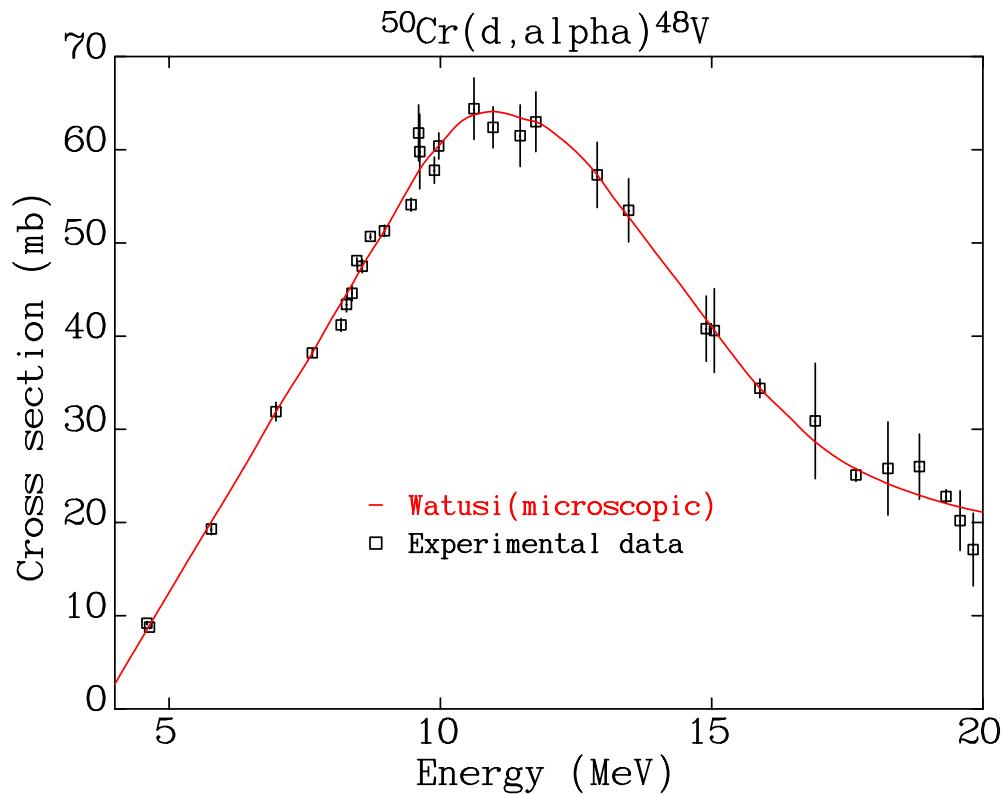


Fig. 6. $^{50}\text{Cr}(\text{d}, \alpha)^{48}\text{V}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 14).

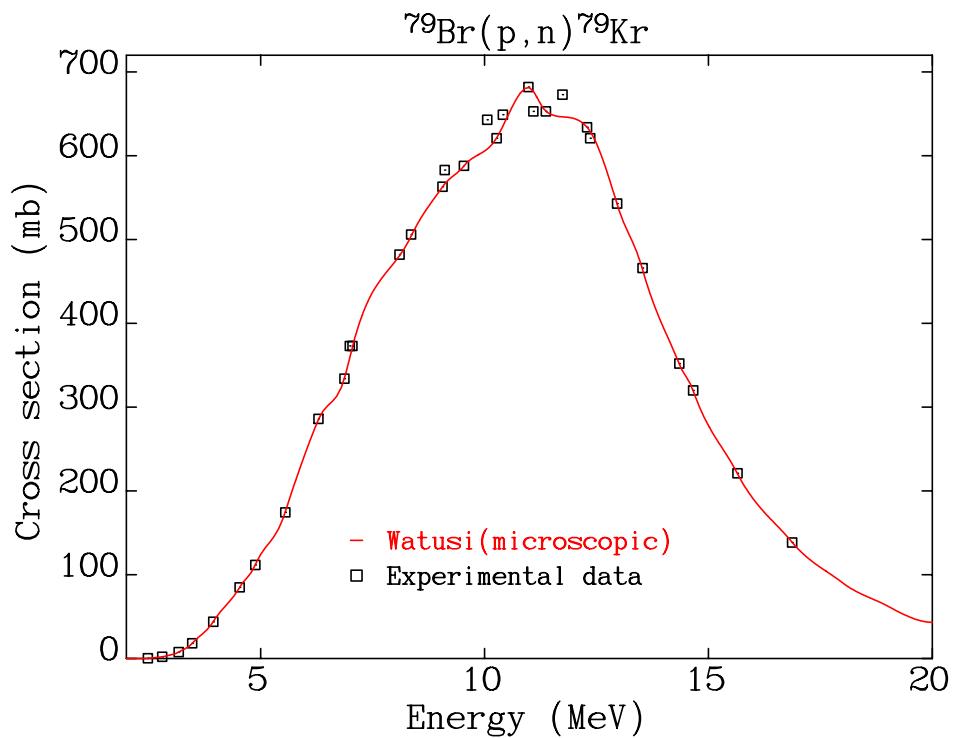


Fig. 7. $^{79}\text{Br}(\text{p}, \text{n})^{79}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against experimental data (Table 15).

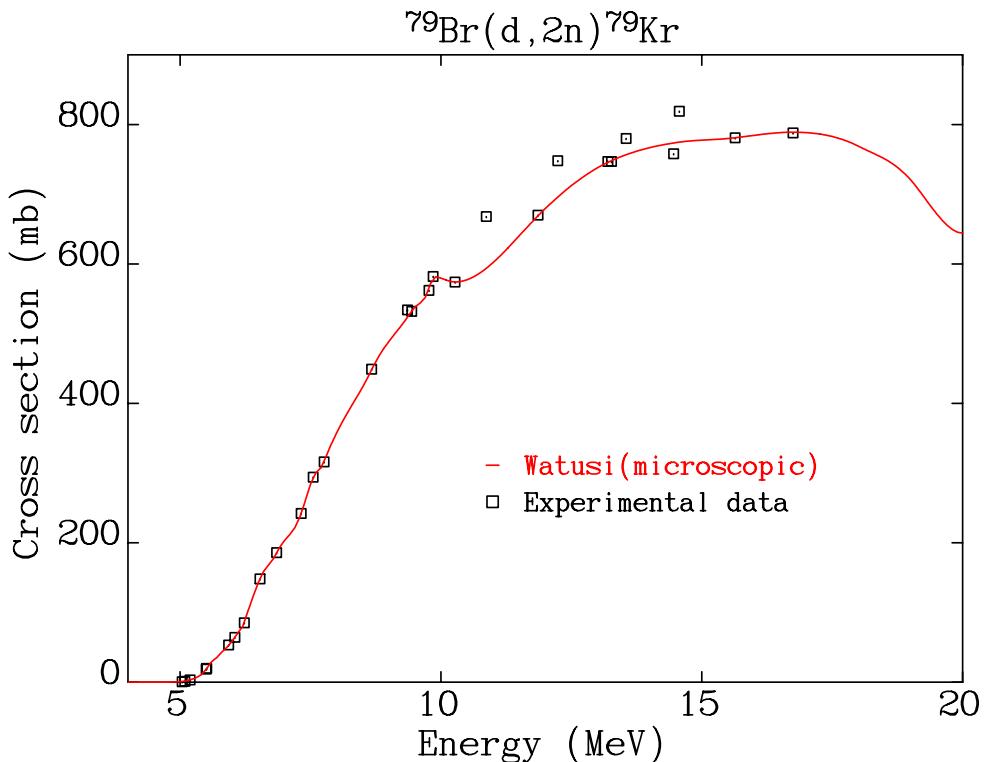


Fig. 8. $^{79}\text{Br}(\text{d}, 2\text{n})^{79}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 16).

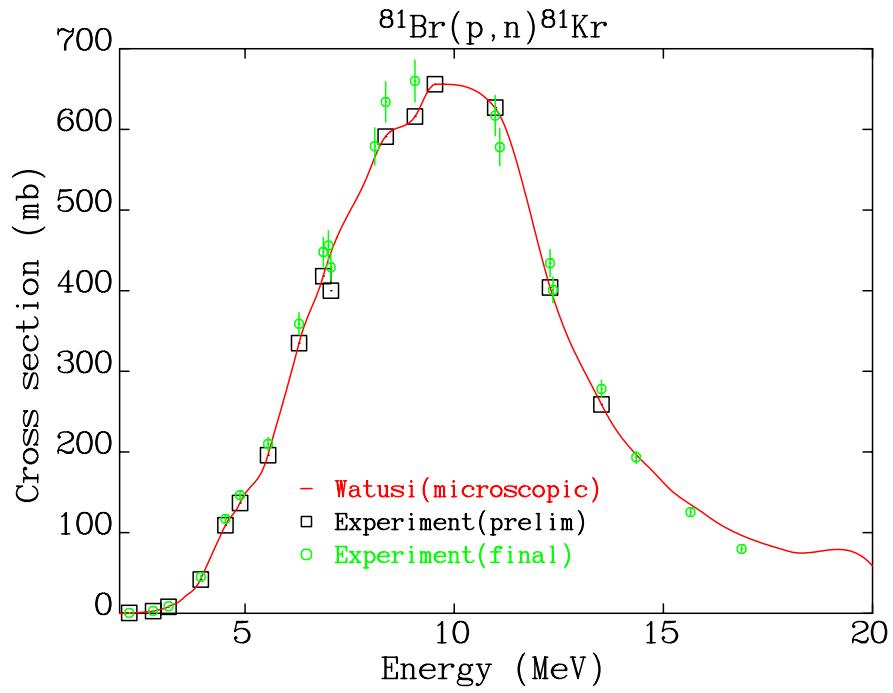


Fig. 9. $^{81}\text{Br}(\text{p},\text{n})^{81}\text{Kr}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data are shown against both the preliminary (black squares) and final (green circles) experimental data (both sets of data are in Table 17).

Note that the Watusi cross sections will need revision.

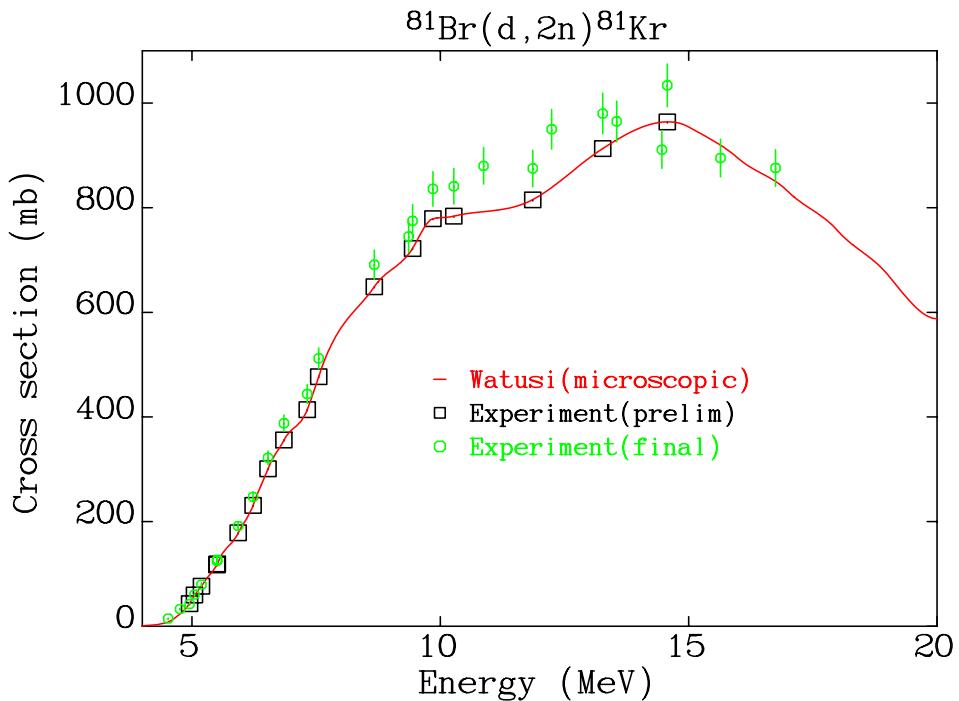


Fig. 10. $^{81}\text{Br}(\text{d},2\text{n})^{81}\text{Kr}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data are shown against both the preliminary (black squares) and final (green circles) experimental data (both sets of data are in Table 18).

Note that the Watusi cross sections will need revision.

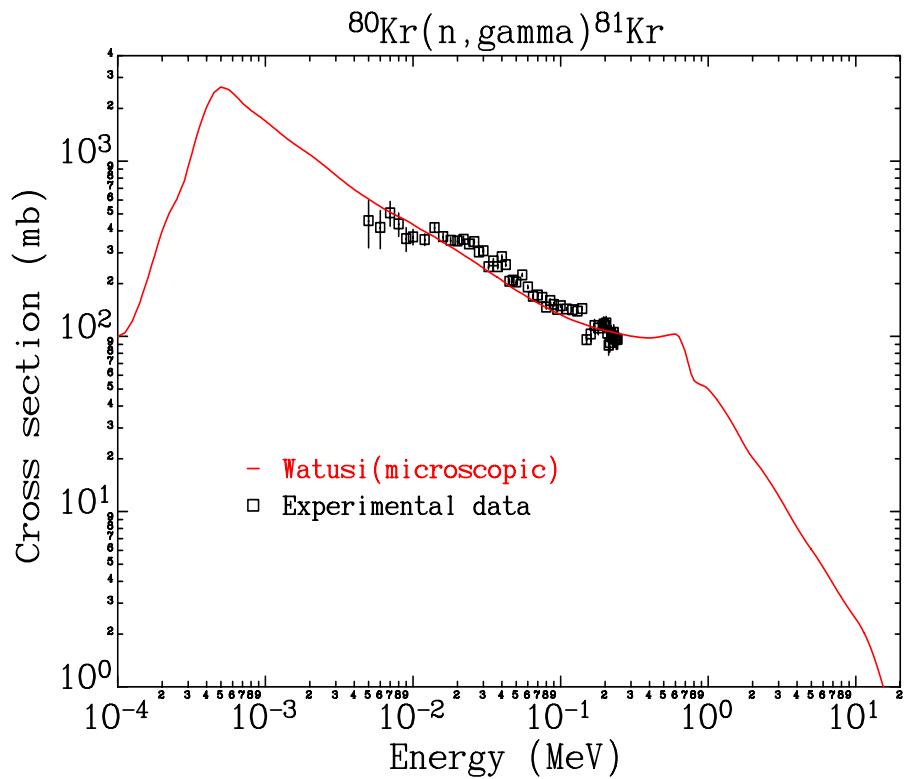


Fig. 11. $^{80}\text{Kr}(n,\gamma) ^{81}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 19).

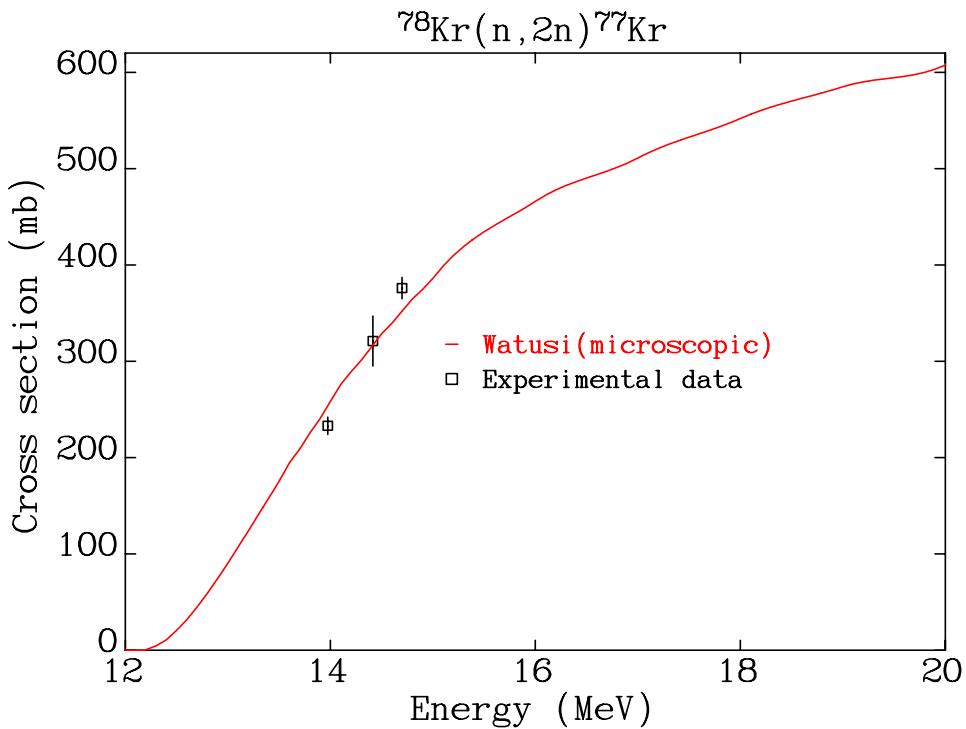


Fig. 12. $^{78}\text{Kr}(n, 2n) ^{77}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 20).

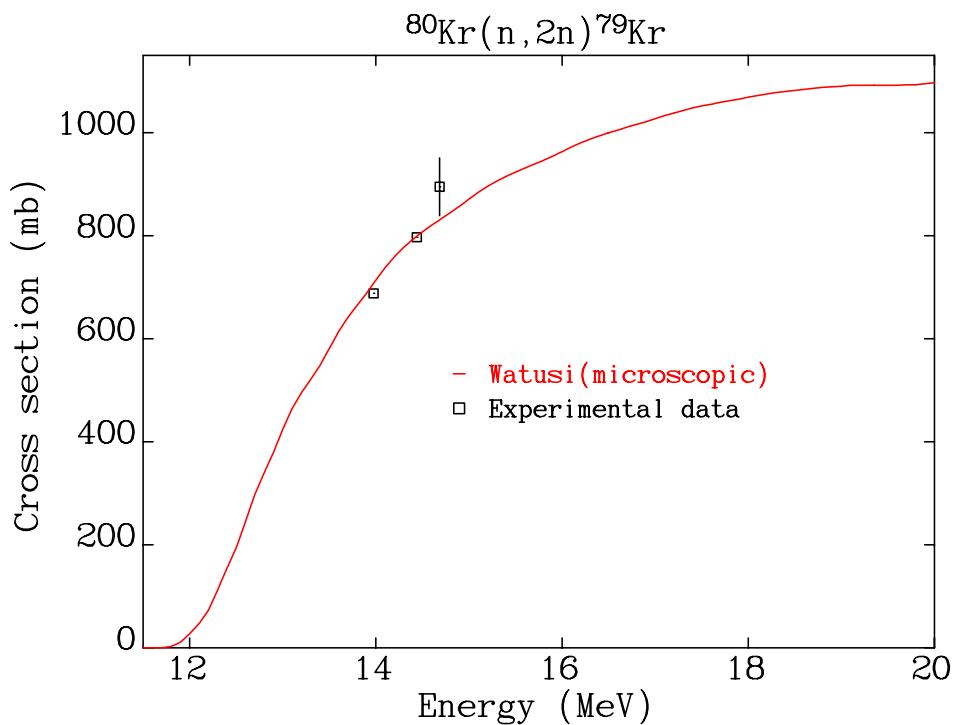


Fig. 13. $^{80}\text{Kr}(n,2n)^{79}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 20).

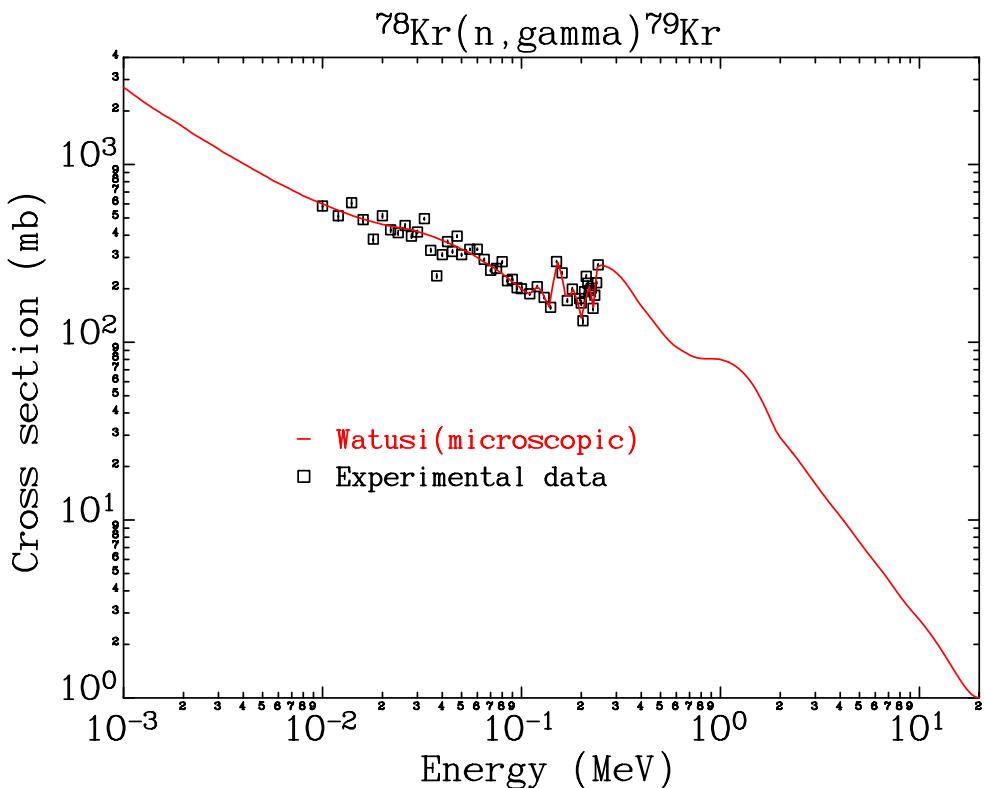


Fig. 14. $^{78}\text{Kr}(n,\gamma)^{79}\text{Kr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 21).

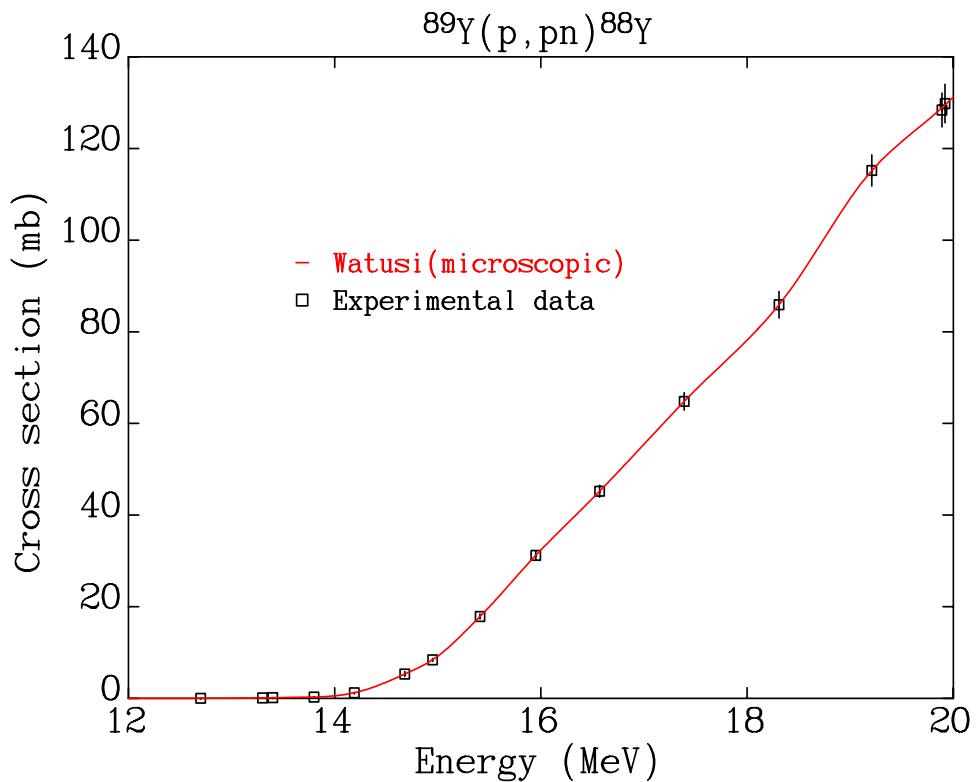


Fig. 15. $^{89}\text{Y}(\text{p},\text{pn})^{88}\text{Y}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 22).

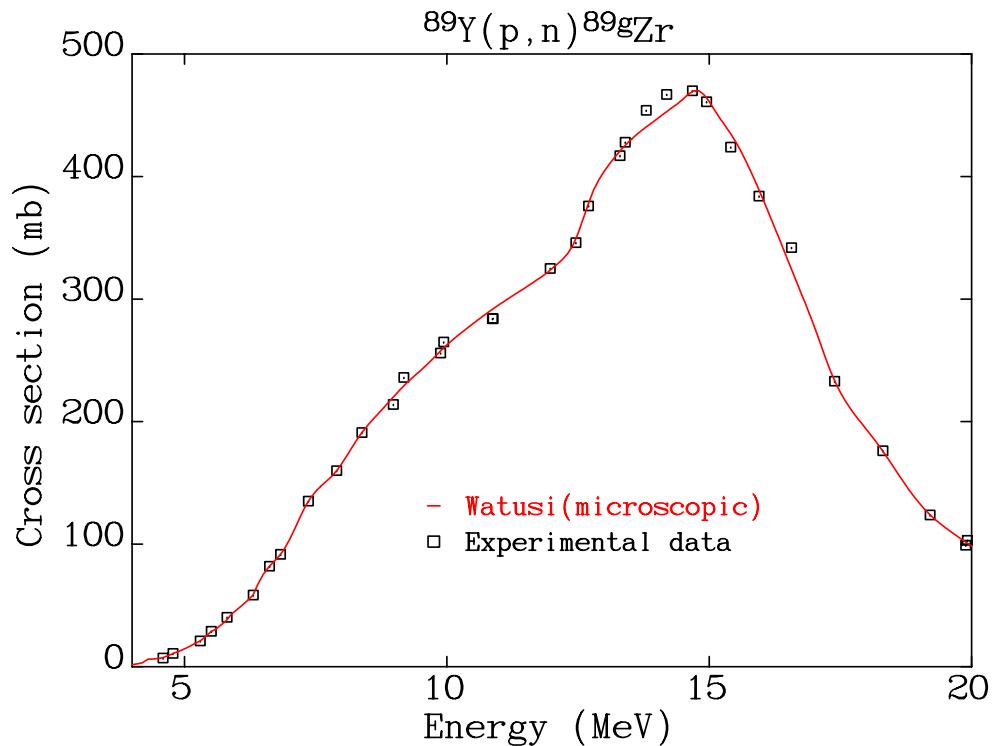


Fig. 16. $^{89}\text{Y}(\text{p},\text{n})^{89\text{gZr}}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 23).

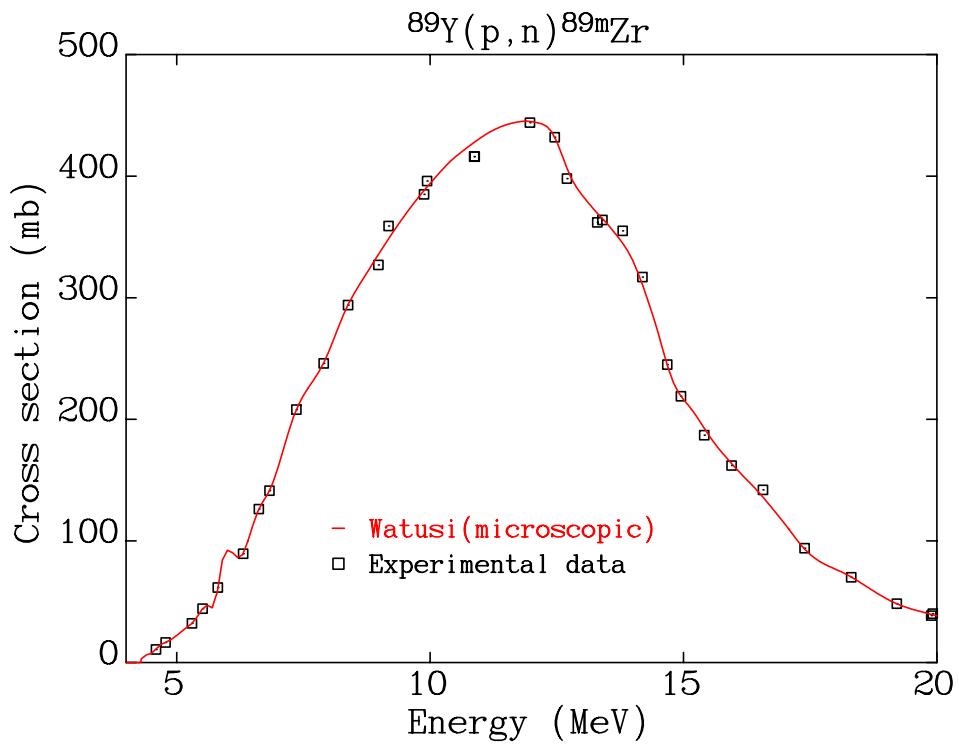


Fig. 17. $^{89}\text{Y}(\text{p}, \text{n})^{89\text{m}}\text{Zr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 23).

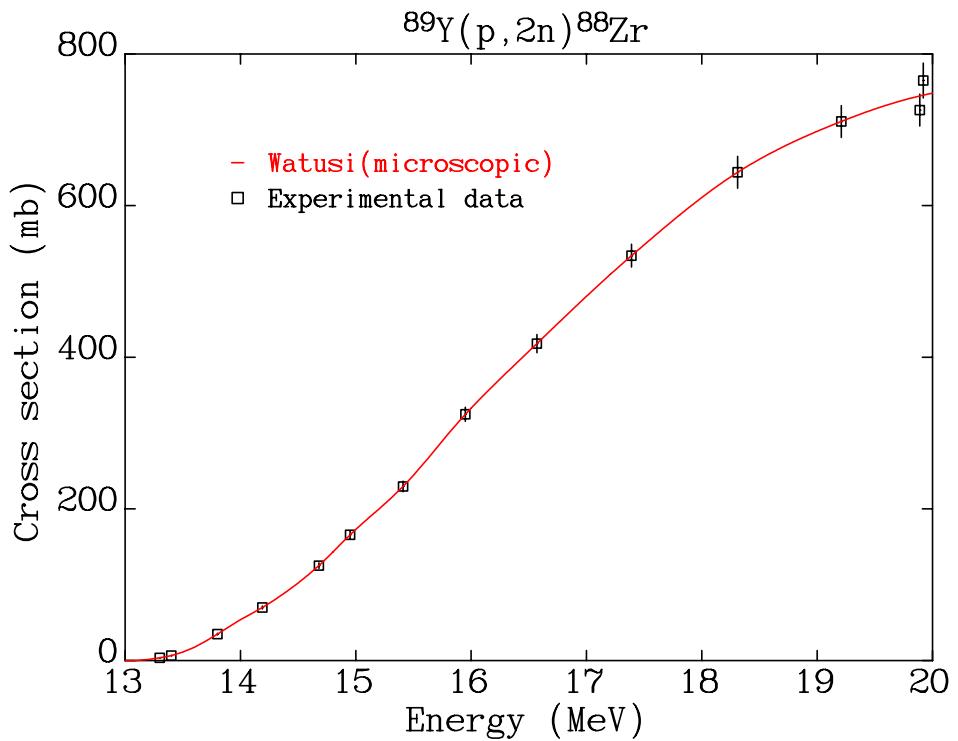


Fig. 18. $^{89}\text{Y}(\text{p}, 2\text{n})^{88}\text{Zr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 24).

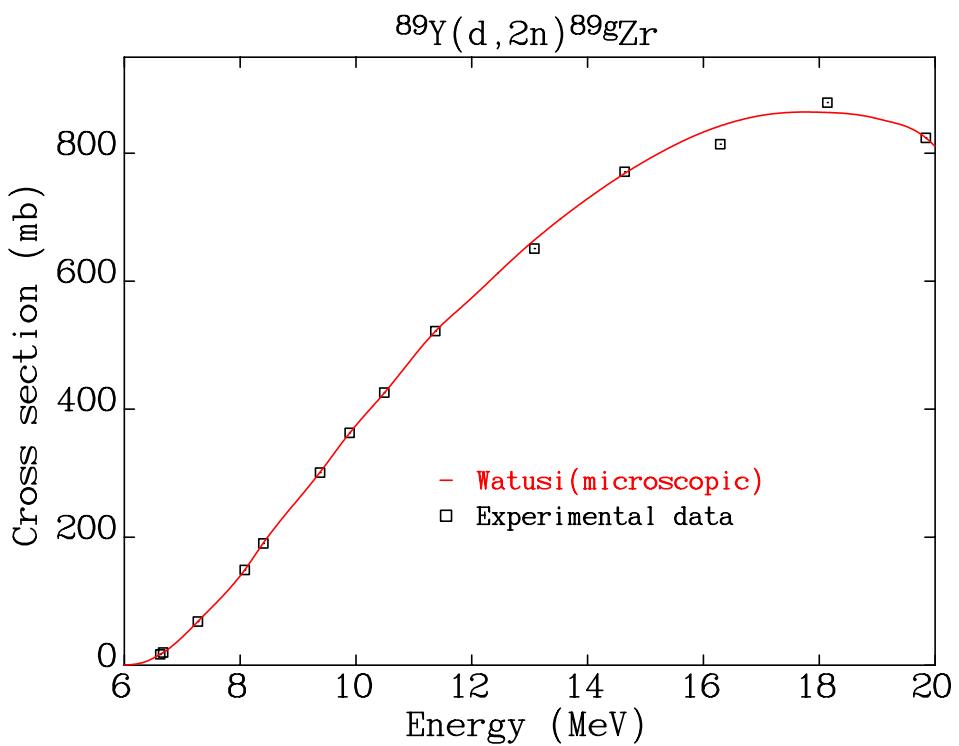


Fig. 19. $^{89}\text{Y}(\text{d}, 2\text{n})^{89\text{g}}\text{Zr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 25).

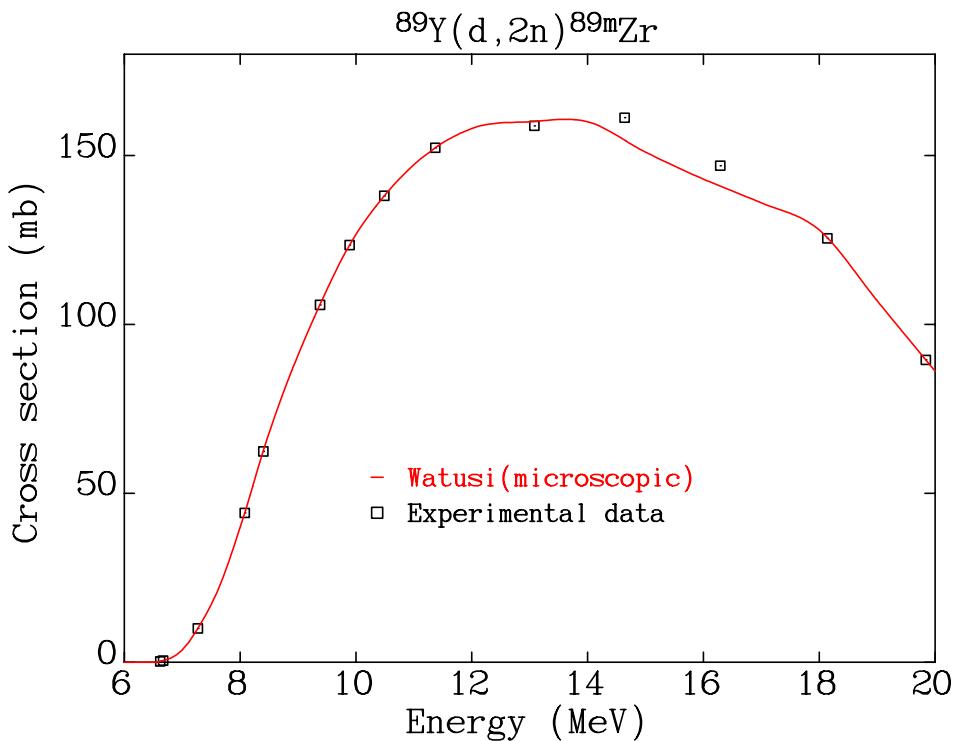


Fig. 20. $^{89}\text{Y}(\text{d}, 2\text{n})^{89\text{m}}\text{Zr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 25).

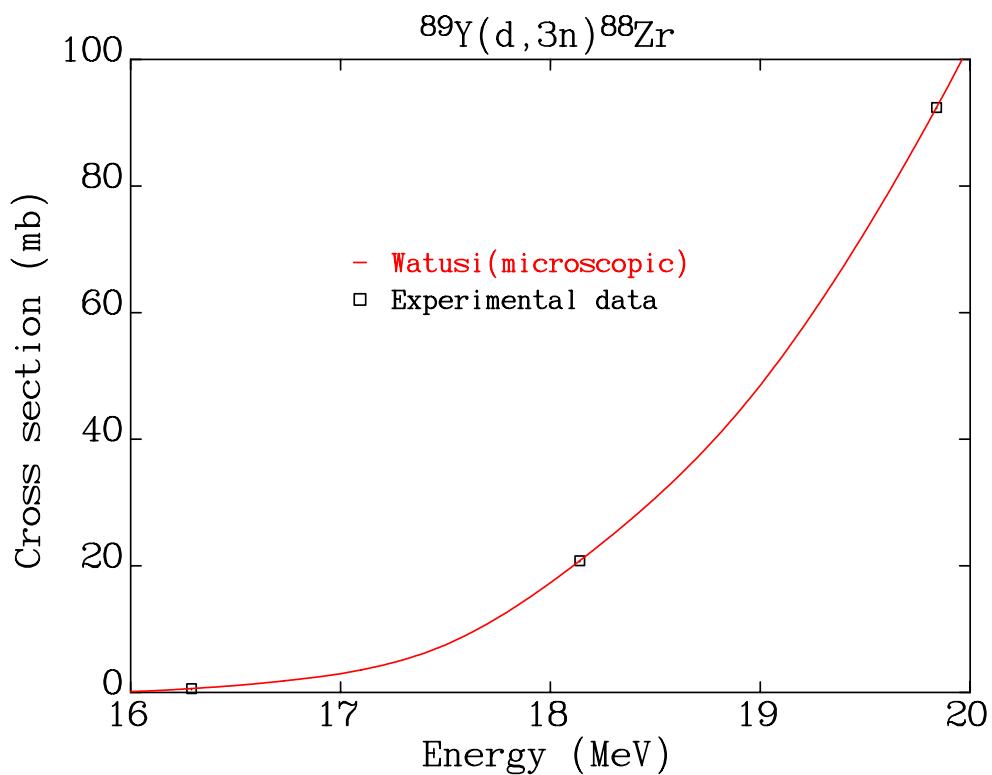


Fig. 21. $^{89}\text{Y}(\text{d}, 3\text{n})^{88}\text{Zr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 26).

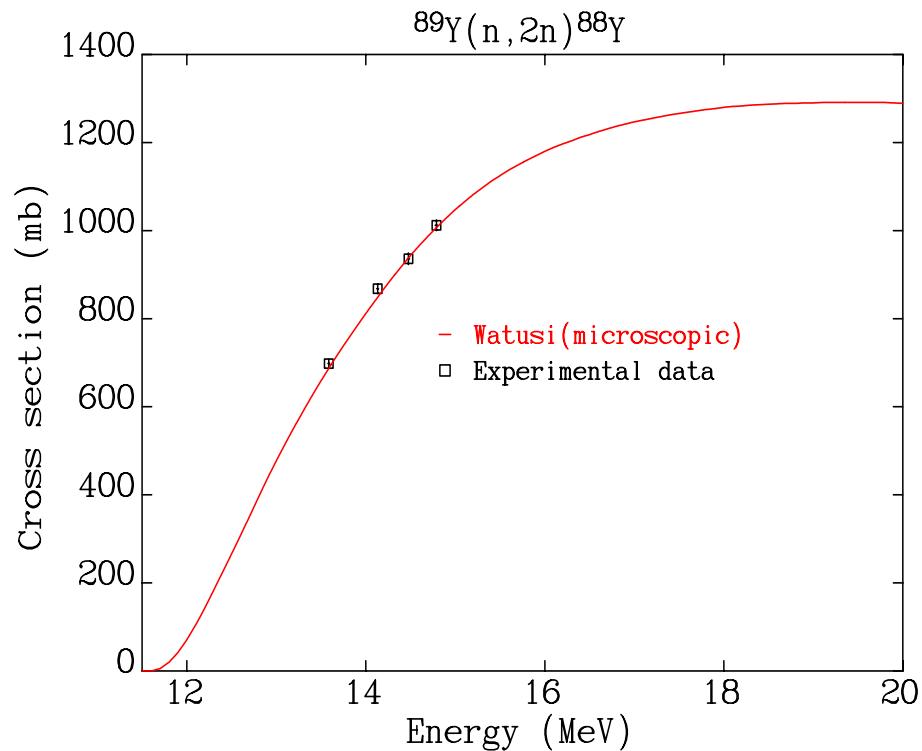


Fig. 22. $^{89}\text{Y}(\text{n}, 2\text{n})^{88}\text{Y}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 29).

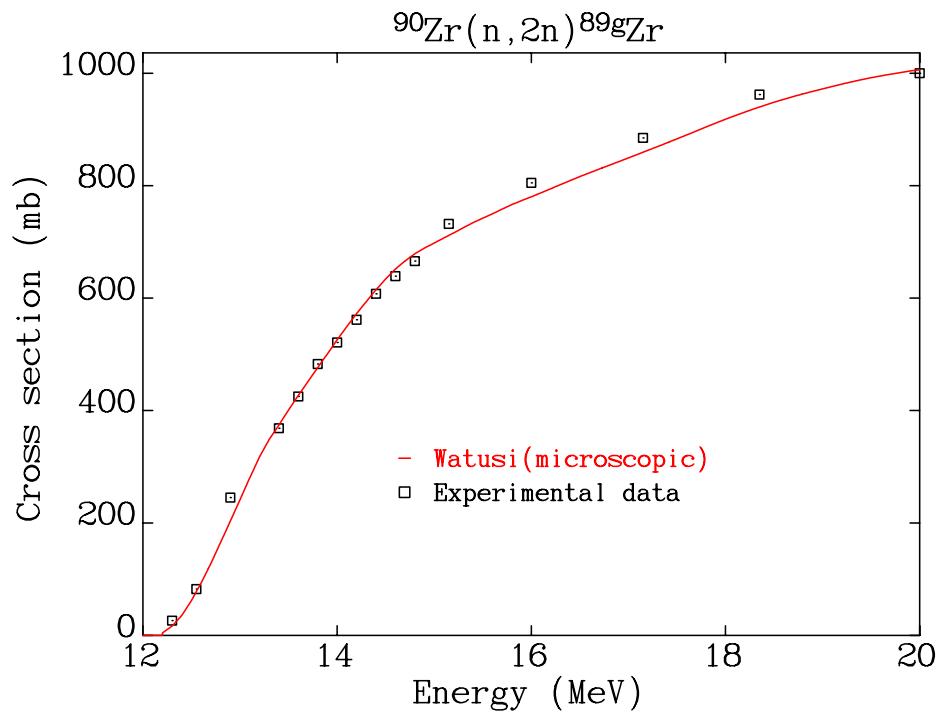


Fig. 23. $^{90}\text{Zr}(n,2n)^{89}\text{gZr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 30).

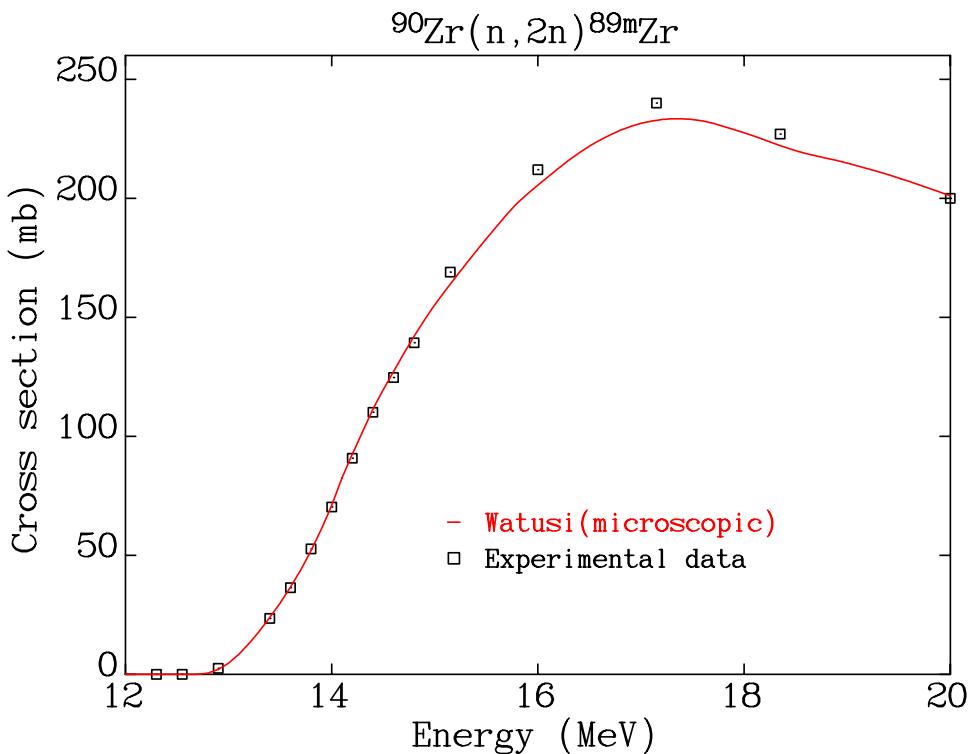


Fig. 24. $^{90}\text{Zr}(n,2n)^{89}\text{mZr}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 30).

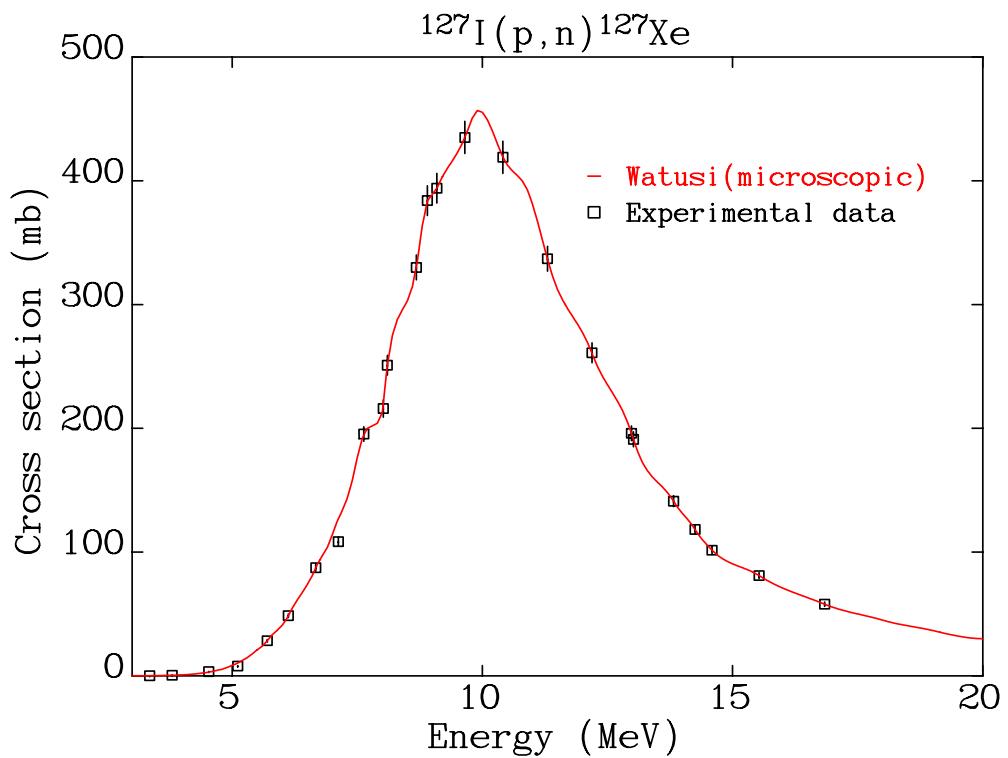


Fig. 25. $^{127}\text{I}(\text{p},\text{n})^{127}\text{Xe}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 31).

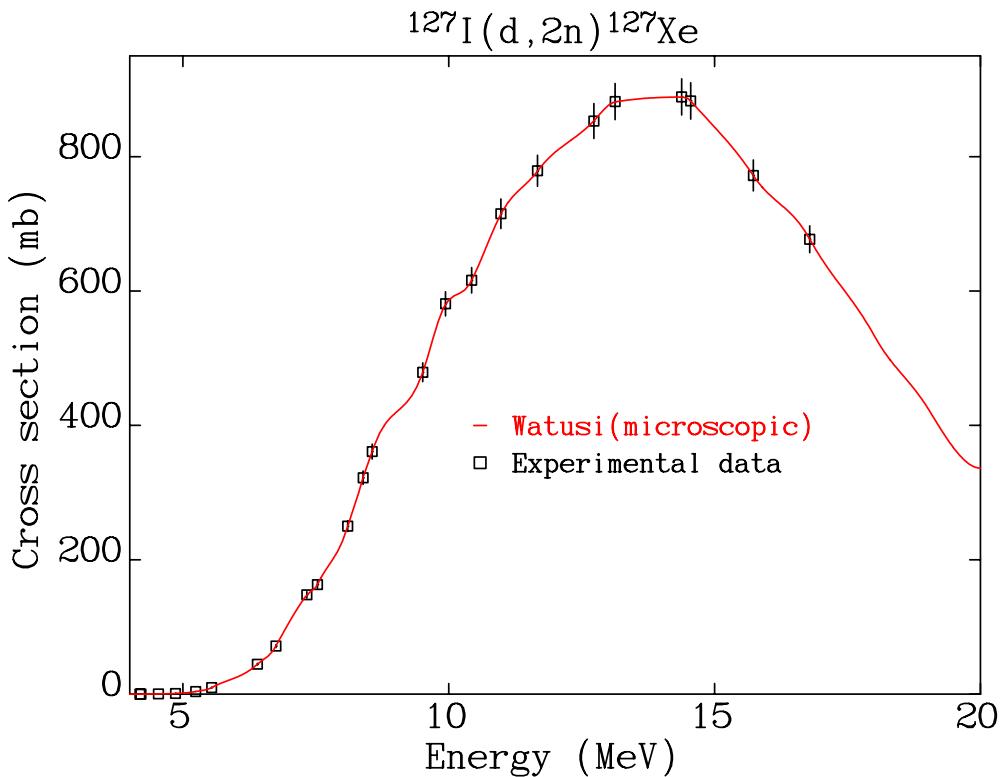


Fig. 26. $^{127}\text{I}(\text{d},2\text{n})^{127}\text{Xe}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 32).

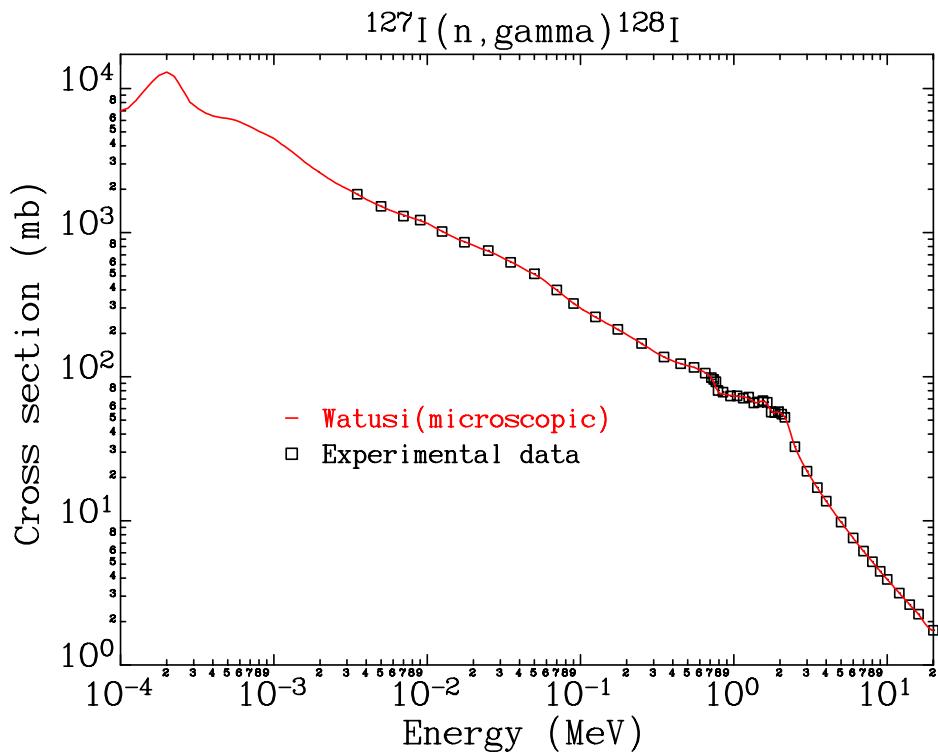


Fig. 27. $^{127}\text{I}(\text{n}, \gamma)^{128}\text{I}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Tables 33 and 34).

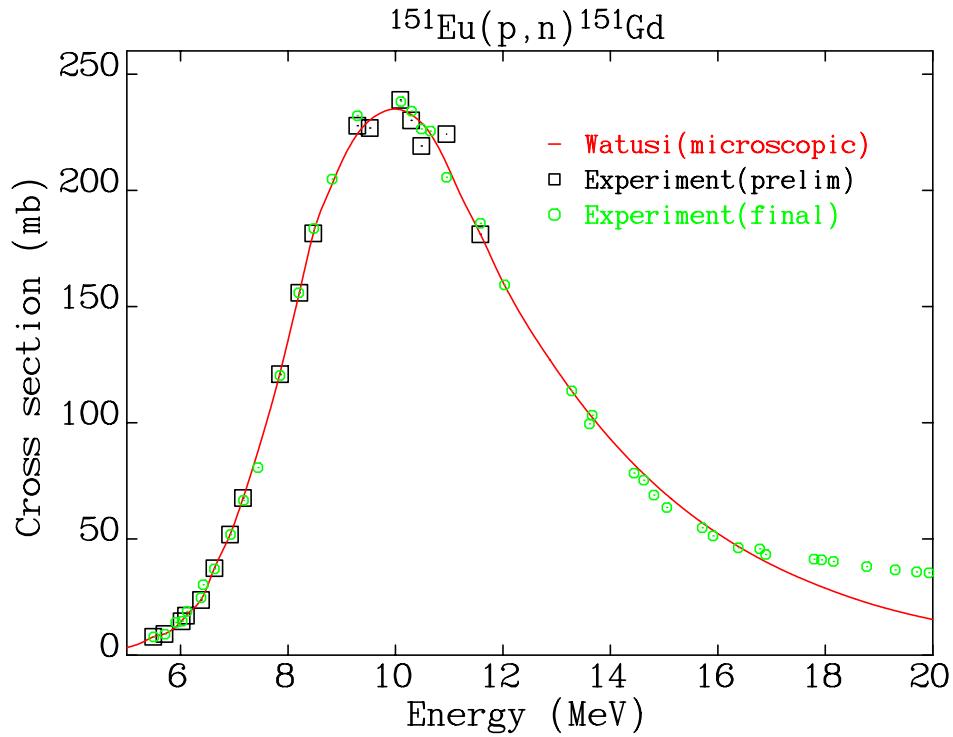


Fig. 28. $^{151}\text{Eu}(\text{p}, \text{n})^{151}\text{Gd}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 35) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 39).

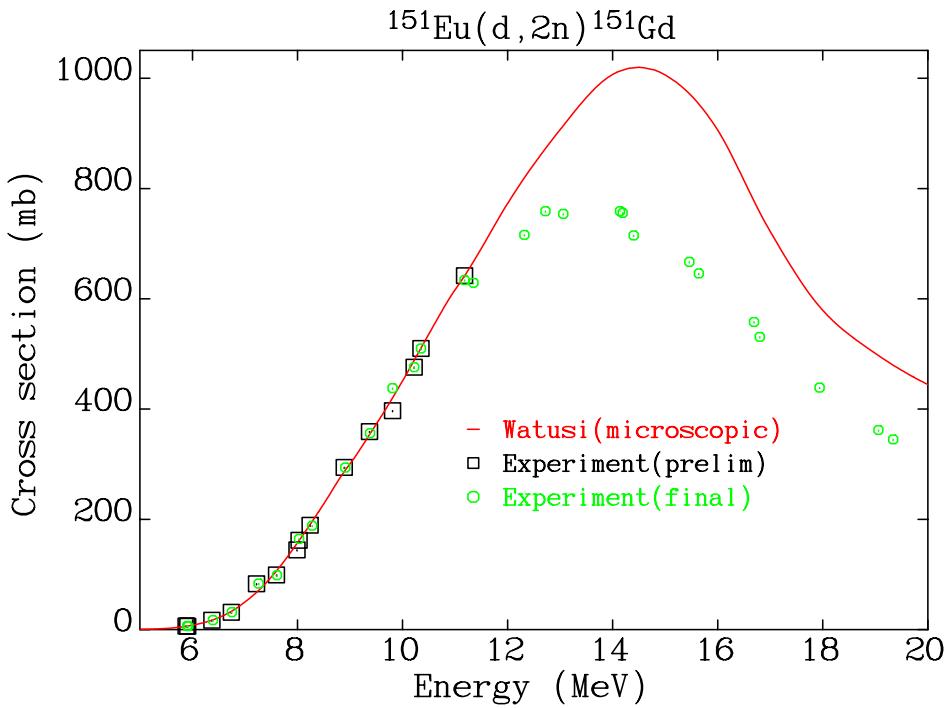


Fig. 29. $^{151}\text{Eu}(\text{d}, 2\text{n})^{151}\text{Gd}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 36) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 40). Note that the Watusi cross sections above 11 MeV will need revision.

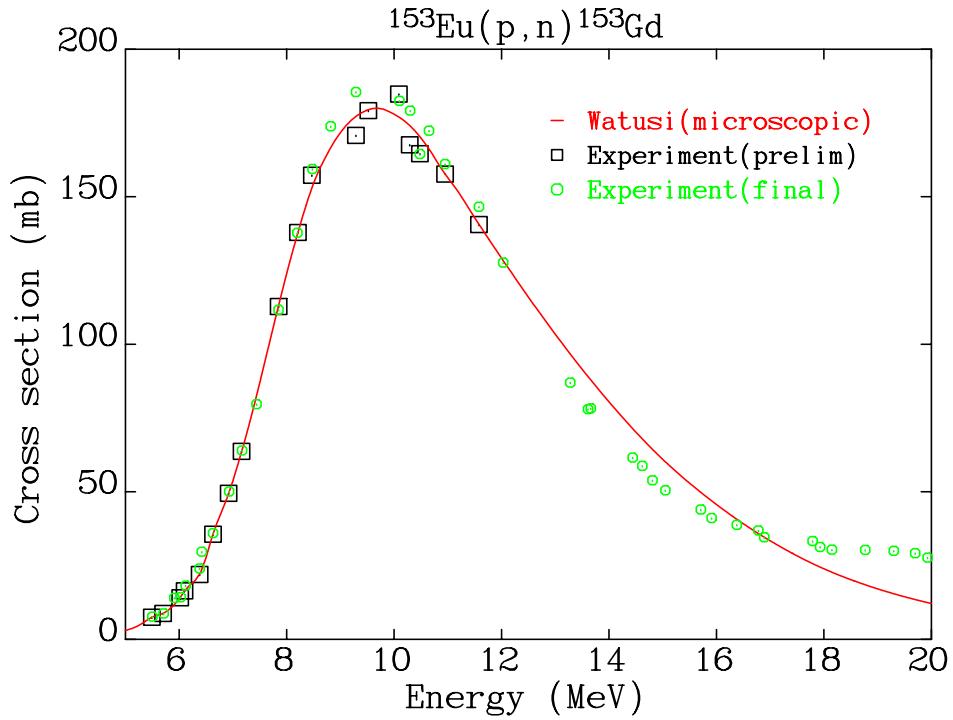


Fig. 30. $^{153}\text{Eu}(\text{p}, \text{n})^{153}\text{Gd}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 37) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 41). Note that the Watusi cross sections above 8 MeV will need revision.

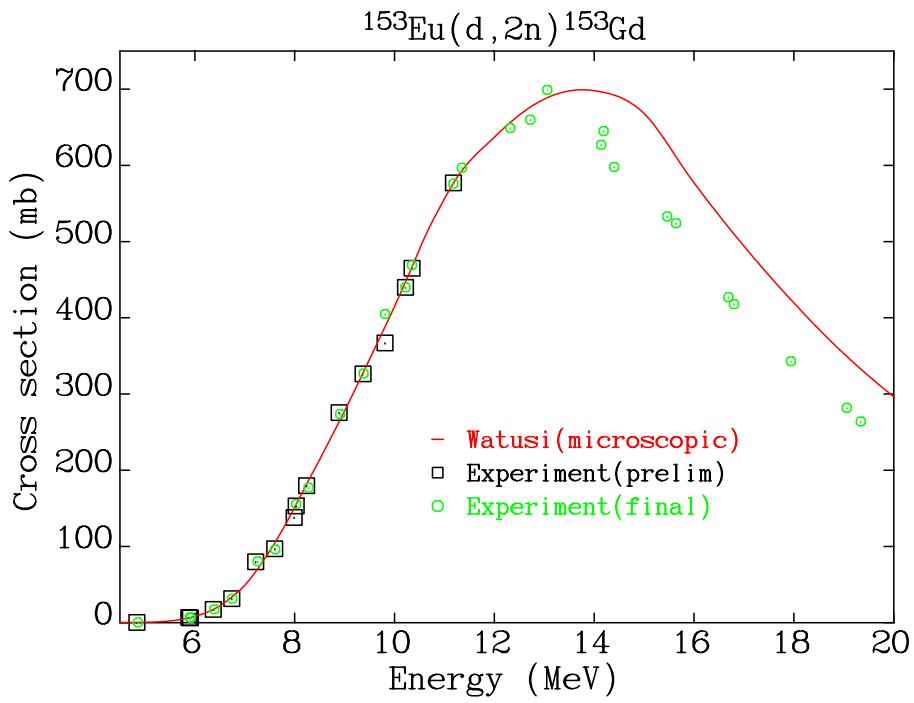


Fig. 31. $^{153}\text{Eu}(\text{d}, 2\text{n})^{153}\text{Gd}$. The Watusi (microscopic) cross sections (red line) obtained from a fit to the preliminary experimental data (Table 38) are shown against both the preliminary (black squares) and the final (green circles) experimental data (Table 42). Note that the Watusi cross sections above 12 MeV will need revision.

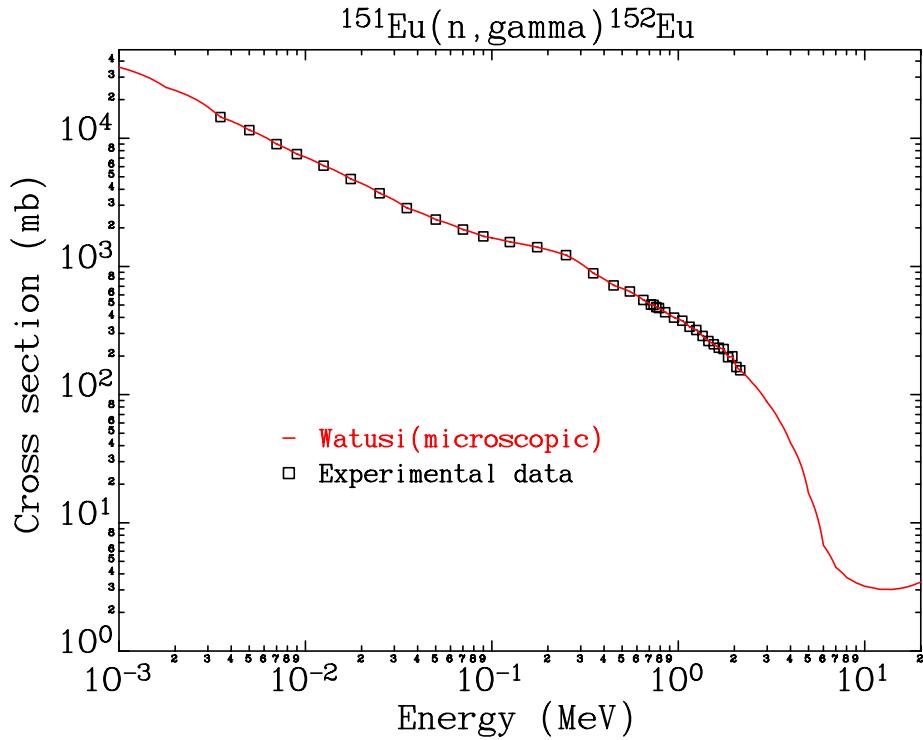


Fig. 32. $^{151}\text{Eu}(\text{n}, \gamma)^{152}\text{Eu}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 43).

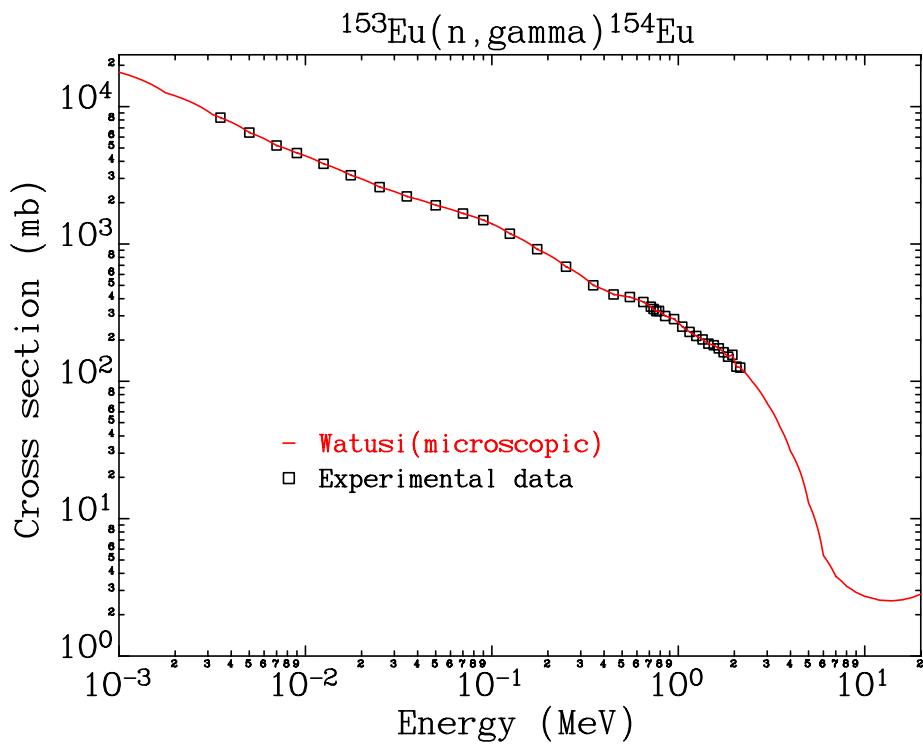


Fig. 33. $^{153}\text{Eu}(n,g)^{154}\text{Eu}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 44).

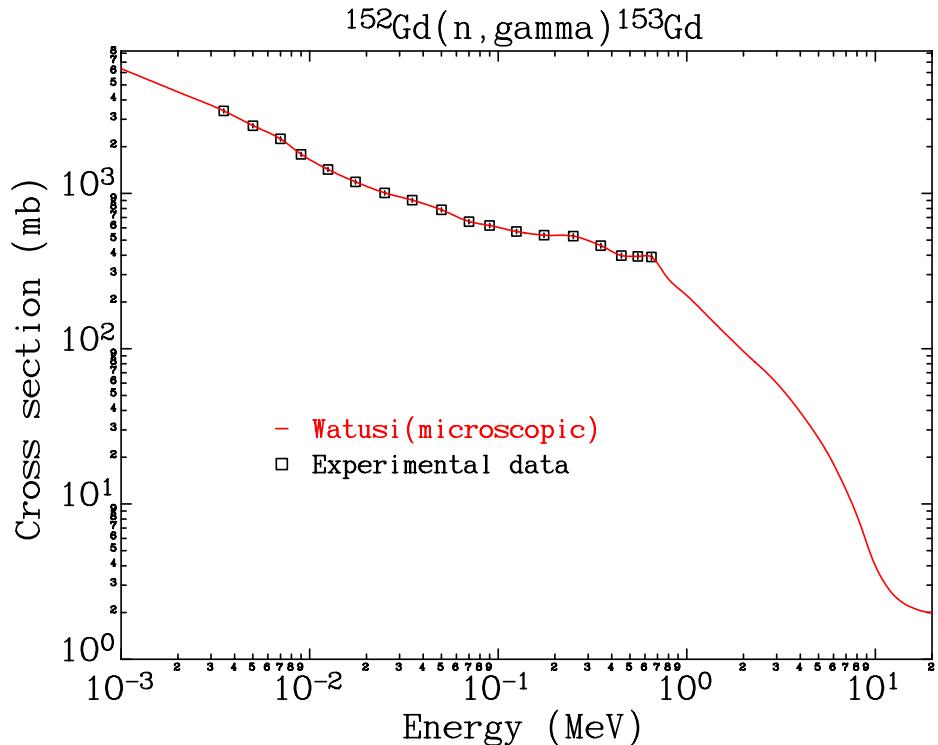


Fig. 34. $^{152}\text{Gd}(n,g)^{153}\text{Gd}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 45).

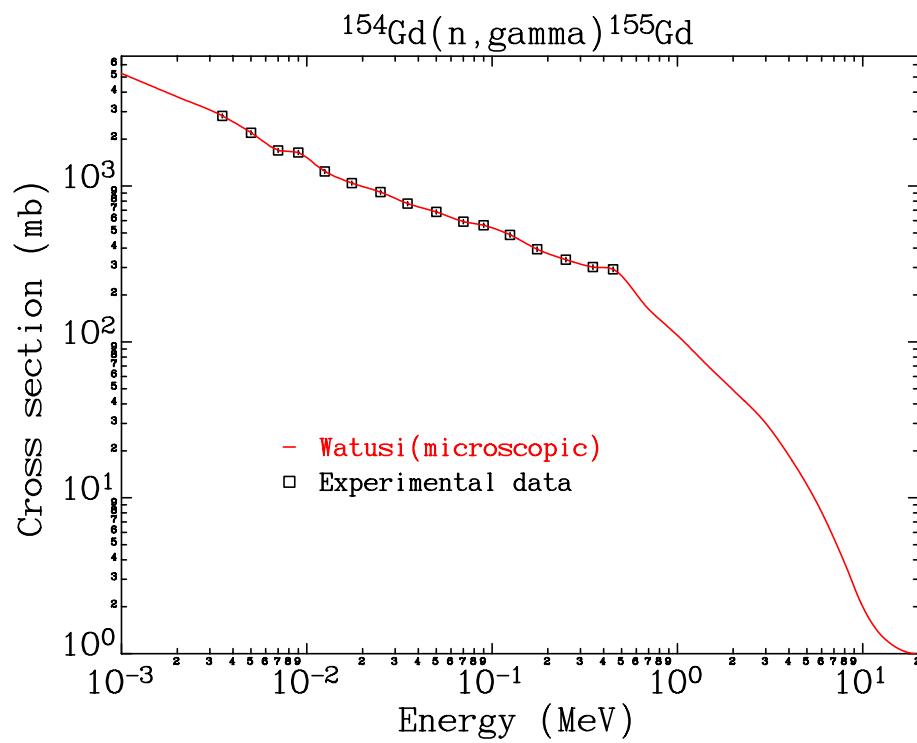


Fig. 35. $^{154}\text{Gd}(n,\gamma)^{155}\text{Gd}$. The Watusi (microscopic) cross sections (red line) are plotted against the experimental data (Table 46).